

MAKERERE



UNIVERSITY

**SONOGRAPHIC SCORING FOR OPERATING ROOM TRIAGE IN TRAUMA;
ACCURACY FOR THERAPEUTIC LAPAROTOMY AMONG BLUNT ABDOMINAL
TRAUMA PATIENTS IN MULAGO HOSPITAL.**

BY

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FOR THE AWARD OF MASTERS OF MEDICINE IN SURGERY OF
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DECLARATION

I declare that this dissertation has not been submitted for another degree in this University or any other University /institution of higher learning and that the views expressed herein are mine unless otherwise stated and where such has been the case, acknowledge or reference has been quoted.

Witness my hand thisday of2013

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DEDICATION

This Book is dedicated to my dear parents Dr Herman Joseph and Bibian Musiitwa, my siblings

Patricia, Herman, Hellen, Valley and Vianney.

You are my pillars and I am grateful for the love and support

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LIST OF ABBREVIATIONS:

ER	Emergency Room
FAST	Focused Assessment with Sonography for Trauma
A &E	Accidents & Emergency
SSORTT Score	Sonographic scoring for operating room triage in trauma
HVI	Hollow viscus injury
CT	Computed tomography
DPT/DPL	Diagnostic peritoneal tap and/or lavage
US	Ultrasound Scan
RTA	Road Traffic Accident
PPV:	Positive Predictive Value
NPV:	Negative Predictive Value
Bpm	Beats per minute
RTCs	Road traffic crash
ROC curve	Receiver Operating Characteristic curve

OPERATIONAL DEFINITIONS:

Hemodynamic instability:

Systolic blood pressure(SBP) less than 90 mm Hg on arrival to the ER, decrease in the SBP during ER evaluation to less than 90 mm Hg, and not responding to resuscitative measures.

Therapeutic laparotomy:

Grade 3, 4 or 5 hepatic or splenic injury, > 1 liter of intraperitoneal blood, hollow viscus injury requiring repair, great vessel injury, left diaphragmatic rupture, pancreatic injury, or bladder rupture

Standard of care investigation:

History and physical examination ,use of investigations e.g. Chest X ray or plain abdominal X-ray and/or full abdominal ultrasound scan for suspected blunt abdominal injury to rule out fluid accumulation and/or specific organ injury.

Grade III shock: Systolic BP \leq 90mmHg and a pulse rate of $>$ 120 bpm

Diagnostic Accuracy: The ability of a test to discriminate between subjects who have the target condition and those who have not.

The reference standard:

Is regarded as the best available method to establish the presence or absence of the target condition in this case hemoperitoneum. It can be a single method, or a combination of methods, to establish the presence of the target condition.

FAST:

Is a specific type of US examination in a setting of trauma which provides a quick overview of the intraperitoneal cavity to detect free fluid, acute hemorrhage and injury to visceral organs.

ROC curve:

A graphic means of assessing the ability of a screening test to discriminate between healthy and diseased people.

ABSTRACT

Background:

Trauma burden globally accounts for high levels of mortality and morbidity mainly associated with diagnostic and treatment delays of Blunt Abdominal Trauma (BAT). Patient's evaluation for BAT remains a diagnostic challenge for emergency physicians and trauma surgeons world over. Focused Assessment with Sonography for Trauma (FAST) has emerged and been embraced as a rapid, noninvasive, and accurate method of evaluating BAT.

SSORTT Score (sum of Ultrasound score, Systolic Blood Pressure and Pulse rate) gives a score that can predict therapeutic laparotomy among BAT patients. Although FAST has been widely accepted and adopted as an adjunct to the initial assessment of trauma patients with suspected BAT, Mulago Hospital is yet to implement the routine use of FAST.

Objective:

To assess the accuracy of SSORTT score for a therapeutic laparotomy by determining the sensitivity, specificity, predictive value.

Study methodology:

A prospective observational study was carried out at the A&E Unit, Mulago hospital from December 2012 to April 2013 conducted by convenient sampling. Eligible patients with BAT were evaluated for presence of hemoperitoneum using SonoSite TITAN® portable ultrasound machine 3.5-5MHz, as well as grade 3 shock (SBP<90mmHg and PR>120bpm). Further evaluation of patients with standard of care (SOC) to determine definitive management. The diagnostic accuracy of SSORTT score in predicting therapeutic laparotomy was determined by follow up of patients for three days and comparing day three outcome with SSORTT score at different cutoffs and SOC.

Results:

In total 195 patients were evaluated the male: female ratio was 6:1. The age group between 20-40 years comprised the majority of patients 153(79%). The commonest injury patterns were head injury 80(42%), followed by abdominal injuries at 54 (28%). SSORTT score cutoff ≤ 1 i.e. SSORTT score >2 appropriately identified 19 of 21 patients that had laparotomy, with sensitivity = 90% Specificity = 90%, PPV = 53% and NPV = 99%. Five patients of 23 who had laparotomy died due to anesthesia and trauma related complications

Conclusion:

SSORTT score is a reliable tool for predicting the need for therapeutic laparotomy, with SSORTT >2 being more predictive than SSORTT scores <1 .

CHAPTER ONE

1.0 Background / Introduction:

Trauma burden globally is on the increase accounting for high levels of mortality and Morbidity. It's the second largest single cause of disease accounting for 16%, only second to parasitic and infectious diseases at 23%. WHO also estimates that by year 2020, trauma will be the first or second leading cause of 'years of productive life lost' for the entire world population in both developed and developing world. ⁽¹⁾

Blunt Abdominal Trauma (BAT), is injury to intra abdominal viscera or retroperitoneal as a result of a non penetrating object or force. It's commonly due to rapid deceleration or acceleration in combination with shearing and rotational forces. With mechanical energy accounting for 75% of all injuries ⁽²⁻³⁾. Common manifestation is hemorrhage and visceral perforation ,either intraperitoneal or retroperitoneal and morbidity and mortality are associated with delay in diagnosis and treatment of BAT. ⁽⁴⁻⁶⁾

Commonly injured in BAT are solid organs like Spleen, Liver, Kidneys, and hollow organs like bowel. Spleen is the most frequently damaged intraperitoneal structure followed by the liver and kidney can also be injured. ⁽²⁾ Less commonly, hollow viscus injury may occur as well as other organs like pancreas, urinary bladder and diaphragm may be injured resulting in discharge of luminal Contents e.g. faecal matter, urine, bile, food particles into the peritoneal cavity resulting in peritoneal irritation and/or intra abdominal sepsis.

Common causes include; road traffic crashes (RTC), industrial accidents, falls from heights, Sporting, farm accidents (in rural areas) and sometimes the cause of BAT is unknown e.g. with child abuse and domestic violence. ⁽⁷⁻⁸⁾

RTCs are the leading cause of injuries irrespective of the age, hospital, and occupation; they represented 44% of all injuries recorded in the Uganda trauma registry in the first half of 2010 ^(4, 9) At

Mulago National Referral Hospital according to records, about 30% of admissions through casualty unit are due to trauma with the majority being due to RTCs.⁽¹⁰⁻¹¹⁾

Studies done in region East & central Africa noted that RTCs were the leading cause of blunt abdominal trauma (BAT).⁽¹²⁾

Most trauma deaths tend to occur at the scene or in the first hour after trauma and are estimated to be up to 50% of all trauma deaths. It's known that these deaths can be prevented by optimizing of trauma care through efficient pre hospital care systems.

Another proportion of patients are lost through delay in receiving appropriate treatment. One aspect of the delay is failure to diagnose life threatening injuries early and appropriately managing them.

Evaluation of patients with BAT is often a diagnostic challenge for emergency physicians and trauma surgeons.⁽¹³⁾ Uncontrolled hemorrhage is responsible for over 50% of trauma related deaths.⁽¹⁴⁻¹⁶⁾

Other times overly aggressive management can lead to non therapeutic laparotomy. The negative laparotomy rate is 16% and negative laparotomy carries the risk of incisional hernia and small bowel obstruction over time.

Focused Abdominal Sonography for Trauma (FAST) has emerged and been embraced as a rapid, noninvasive, and accurate method of evaluating blunt abdominal trauma that can be easily used by emergency room clinicians and trauma surgeons.⁽¹⁷⁻¹⁹⁾ (FAST) is a rapid, four-view ultrasound examination carried out during the primary survey that assesses for haemoperitoneum, hemothorax and hemopericardium.

The great value of FAST lies in its high sensitivity for detecting intraperitoneal fluid which accumulates in dependent areas around the liver, spleen and pouch of Douglas. This sensitivity may reach up to 100%. The finding of free intraperitoneal fluid in a hypotensive patient alerts the treating doctor that the patient may need an urgent laparotomy.

Other diagnostic tools available to the clinician include Diagnostic peritoneal lavage (DPL) which has been the gold standard to detect intraperitoneal fluid since the sixties and more recently helical CT scan

which has dramatically changed our methods for diagnosing blunt abdominal trauma and has markedly reduced the rate of missed intra-abdominal injury.

The choice of a particular modality depends on the hemodynamic stability of the patient, the reliability of physical examination, the severity of associated injuries, and the availability of a particular diagnostic modality.

Within the last twenty years, the use of FAST has replaced the use of DPL for detecting intraperitoneal bleeding in the majority of patients, particularly those who are hypotensive. ⁽²⁰⁾

FAST is useful as the initial diagnostic tool for abdominal trauma to detect intraabdominal fluid. With proper training and understanding the limitations of ultrasound, the results of FAST can be optimized.

To provide a more meaningful estimate of intra-abdominal fluid volume, hemoperitoneum scoring systems have been developed and those that incorporate physiologic parameters have been found to more accurately predict the need for therapeutic laparotomy. ⁽²¹⁻²²⁾

The Sonographic Scoring for Operating Room Triage in Trauma (SSORTT Score) was developed in a trauma centre in the United States of America with the aim of enabling emergency room clinicians make quick decisions to reliably predict which patients had a very low likelihood of requiring an emergent laparotomy. It has three components;

1) FAST findings, 2) systolic blood pressure and 3) pulse rate which together give a score that can predict whether patient would most likely not require a therapeutic laparotomy.

The importance of this lies in the fact that clinician can rapidly and non-invasively determine that a trauma patient does not need urgent laparotomy and also may help the treating physician decide whether to transfer the patient to a trauma center in the case of peripheral hospital or to manage patient non operatively .

In a centre like Mulago Hospital, basing on the SSORTT score, decisions to manage patients operatively or non operatively could be made.

This study seeks to validate this scoring system in our setting and also determine its diagnostic accuracy and also determine the factors associated with surgery among patients with BAT in Mulago Hospital.

Despite the known benefits of FAST and its recommendation for use in the emergency department, it hasn't been embraced partly because of lack of training among Emergency physicians and its user variability. The purpose of this research is to determine the diagnostic accuracy of SSORT score in BAT patients by using the standard of care as the reference standard.

1.1 Problem Statement:

BAT is a diagnostic dilemma for emergency room physicians and surgeons even in trauma centres in the developed world.

In the developing world and in particular in Mulago Hospital, most trauma deaths tend to occur at the scene of accident or in the first hour after trauma. Up to 50% of deaths occur within the first hour mainly due to inefficient pre hospital care systems, failure to diagnose life threatening injuries early and appropriately manage them as well as delays in timely decision making on whether patient will need therapeutic laparotomy.

Ultrasound, a vital assessment tool of trauma patients is available for use in the Emergency room during regular working hours at Mulago Hospital Accident & Emergency department, though may be less available during after duty hours as coverage is by on call staff. Hence access to imaging services may be delayed affecting vital management decisions.

Although FAST has been widely accepted and adopted as an adjunct to the initial assessment of trauma patients with suspected BAT using the ATLS protocol globally(17-19),Mulago Hospital Accidents & Emergency department is yet to implement the routine use of FAST.

This study which utilizes SSORTT score, three parameters readily available to the emergency physician to predict which patients with BAT would not require therapeutic laparotomy urgently and also predict those that most likely would require therapeutic laparotomy.

1.2 Conceptual Frame work

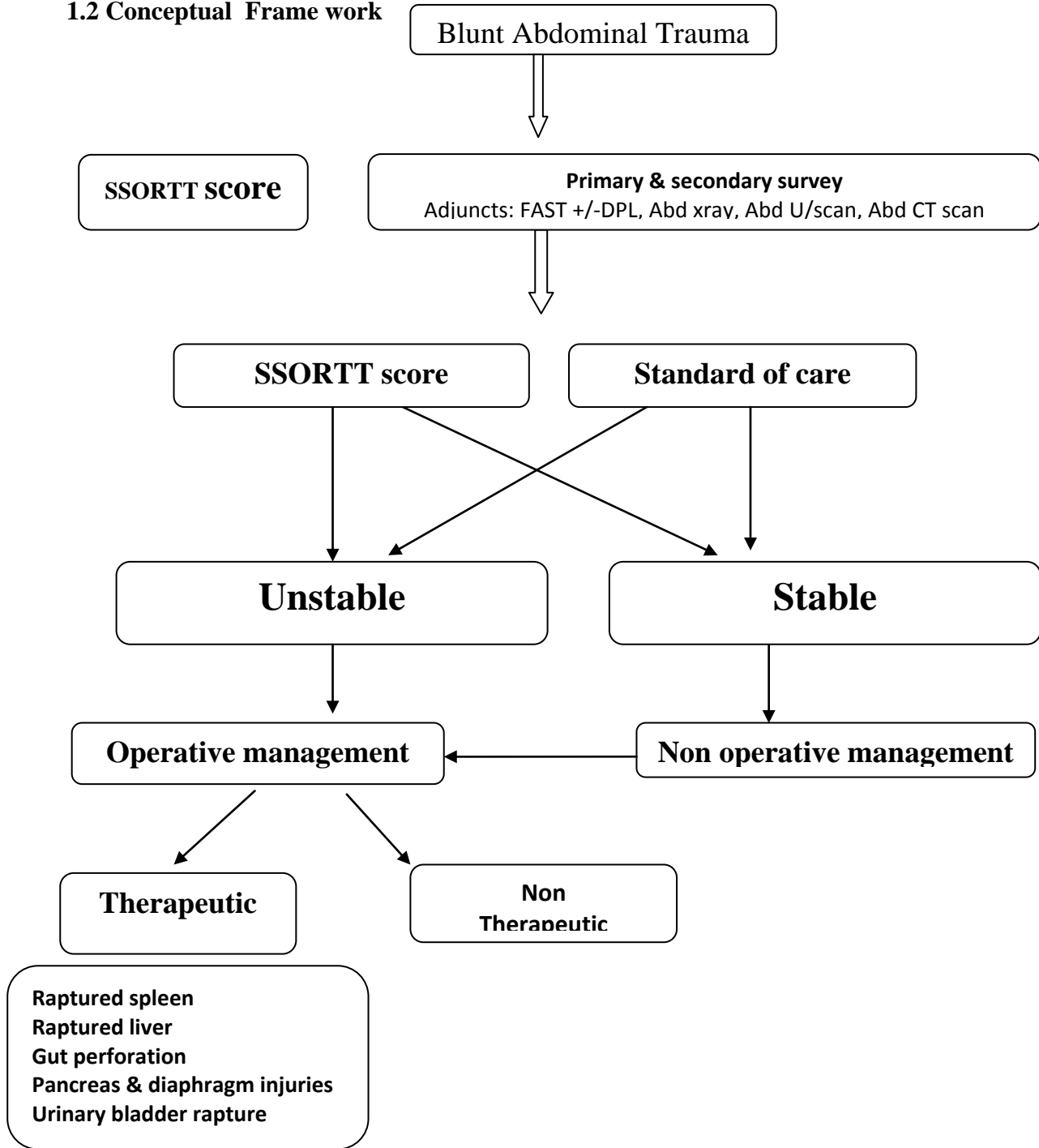


Figure 1: Conceptual framework

1.3 Justification:

Global use of FAST in the emergency room has been embraced and is a very useful adjunct to the primary survey. Current practices in the A &E in the identification of patients with BAT depend mainly on clinical assessment of the doctor in the Emergency room.

Studies have shown that physical examination alone is an insensitive predictor of intra-abdominal injury in the setting of BAT .Making FAST a good screening tool for BAT because of its high negative predictive value.(23-24)

Swift identification of intra-peritoneal bleeding and prompt and appropriate laparotomy reduces unnecessary morbidity and mortality. A number of studies have used various types of hemoperitoneum scoring systems to try to determine the need for a therapeutic laparotomy, some among patients who are hypotensive and others not. No studies on scoring systems for BAT have been done in Mulago; only one study on the patterns of EFAST has been done. ⁽⁹⁾

This study which uses the SSORTT score will validate its diagnostic accuracy in predicting therapeutic laparotomy.

Radiology imaging services though available in the emergency department, their role in emergency setting is limited by delays to diagnose BAT among multiply injured patients.

According to Kirya (1999), missed intra abdominal injuries in BAT (ruptured spleen, ruptured liver, perforated colon, etc) accounted for 29.5% of preventable deaths in major trauma patients.⁽²⁵⁾

Sonographic scoring for operating room triage in trauma (SSORTT score) a new scoring system designed to utilize parameters that are readily available to the Emergency physician and are predictive of those that may require therapeutic laparotomy. Being that it is a new scoring system designed to benefit clinicians in peripheral hospital in decision making, it needs to be validated in our setting. Only one prospective study has been done which recommends that this scoring system needs first to be validated in settings of intended use. In our setting no previous studies have been done on scoring systems as predictor of laparotomy.

This Study therefore intends;

1. To use SSORTT score to predict which patients with BAT would need a therapeutic laparotomy. Once validated this score could be used by medical personnel in Mulago and even in peripheral hospitals in making decisions whether patient needs to be referred to higher centre because of the likelihood of needing a laparotomy versus non-operative management.
2. This study is also intended to improve on the assessment of patients with blunt abdominal trauma in the emergency setting and also bring to the forward the need to equip medical personnel in the emergency room with skills in identifying hemoperitoneum in the cases of BAT.

1.4 Research Question:

In patients with blunt abdominal trauma, is a SSORTT score a good predictor of a therapeutic laparotomy?

1.51 General Objective:

To determine the diagnostic accuracy of SSORTT score in predicting a therapeutic laparotomy among blunt abdominal trauma.

1.52 Specific Objectives:

- To determine sensitivity of SSORTT for therapeutic laparotomy in BAT patients.
- To determine specificity of SSORTT for therapeutic laparotomy in BAT patients.

1.6 Hypothesis:

Null hypothesis:

Specific SSORTT scores among BAT patients are not predictive of a therapeutic laparotomy.

Alternate hypothesis:

Specific SSORTT scores among BAT patients are predictive of a therapeutic laparotomy.

CHAPTER TWO

2.0 Literature Review:

Ultrasound is a diagnostic technique which uses inaudible Sound in the frequency of 1-12 MHz⁽²⁶⁻²⁷⁾ US is readily available, requires minimal preparation time, and may be performed with mobile equipment that allows greater flexibility in patient positioning than is possible with other modalities. It also is effective in depicting abnormally large intraperitoneal collections of free fluid, which are indirect evidence of a solid organ injury that may requires immediate surgery⁽²⁸⁾

The use of US in evaluating BAT was first reported in 1971 in Germany where Kristensen JK et al described its use in the diagnosis of splenic hematomas.⁽²⁹⁾

Since late 1980s and early 1990s, US is used in several trauma centers in Europe and Japan, but it was not until early 1990s that emergency physicians in the North America began showing interest in the use of US for blunt abdominal trauma.⁽³⁰⁾

Evaluating patients who have sustained blunt abdominal trauma (BAT) remain one of the most challenging and resource intensive aspects of acute trauma care. Ultrasound has emerged over past two decades as the optimal screening procedure for patients of BAT in the emergency department as its less expensive, fast, accurate, easy to perform and portable. Studies have demonstrated screening US to have a specificity of 96% and an overall accuracy of 96% in the detection of intraabdominal injury replacing DPL.⁽³¹⁾

Advantage on US over DPL is it provides the information about retroperitoneal hemorrhage, of hemoperitoneum, presence of parenchymal injury, pericardial effusion and haemothorax.

However, US is highly sensitive for the detection of free intraperitoneal fluid but not sensitive for the identification of organ injuries with sensitivity of 41.4% to detect parenchymal injuries on US.⁽³²⁻³⁵⁾

CT scan of the abdomen has a high sensitivity in identifying intraperitoneal blood, detecting retroperitoneal hematomas and characterizing the magnitude of solid organ injuries even without hemoperitoneum. However, its disadvantages over US include higher costs, use of iodinated contrast

medium that places the patient at risk of aspiration, and high radiation exposure including patient needs to be transported, which may be problematic for the severely injured patient in unstable condition.

2.1 Hemoperitoneum:

In evaluation of the abdominal cavity in BAT patients, the main focus is detection of free fluid. Occasionally, hemoperitoneum always accompanies intraabdominal injury, with the exception of an intact subcapsular process. McKenney et al⁽³⁶⁾ have reported solid organ injury without hemoperitoneum in 7% of BAT patients. Kimberley et al⁽³⁷⁾ and Rozycki et al⁽³⁸⁾ advocate the most common site of fluid accumulation, regardless of the site of injury as RUQ or more precisely the Morrison's pouch.

Free fluid will usually appear echo free but may be hypoechoic with a few internal echoes. At the site of injured solid organ, there is often echogenic blood that may be less obvious than the hypoechoic or echo free fluid so should not be overlooked.

The minimum amount for detecting hemoperitoneum is a subject of interest Kawaguchi et al.⁽³⁹⁾ found that 70 ml of blood could be detected, while Tiling et al⁽⁴⁰⁾ found that 30 ml is enough to be detected with ultrasound. They also concluded that a small anechoic stripe in the Morrison's pouch represents approximately 250 ml of fluid, while 0.5cm and 1cm stripes represent approximately 500 ml and 1L of free fluid respectively.

2.2 Focused Assessment with Sonography for Trauma (FAST)

FAST is performed by trauma surgeons, emergency physicians or radiologists in the Emergency Department. The patient is placed supine though standard placement of the patient is not always possible and the depth of ultrasound wave penetration for abdominal US must be at least 20 cm, which usually requires the use of a 3.5–5.0-MHz convex transducer.

FAST) was coined by Rozycki et al in 1995 to describes a limited (four-view) ultrasound assessment of the abdomen looking for haemoperitoneum, and of the heart looking for haemopericardium. The aim is to identify life-threatening intra-abdominal bleeding or cardiac tamponade with a view to expediting definitive surgical management. It does not aim to exclude abdominal or thoracic injury.

While performing FAST, the following four standard views should be obtained

- (a) Transverse view of the subxiphoid region to diagnose pericardial effusion and Injuries to the left lobe of the liver;
- (b) Longitudinal view of the right upper quadrant to show the right lobe of the liver, the right kidney, and the space between the two (the Morison pouch), which may fill with peritoneal fluid when the patient is supine;
- (c) Longitudinal view of the left upper quadrant to show the left kidney, the spleen, and the space between them, which also may contain free intraperitoneal fluid; and
- (d) transverse and longitudinal views of the suprapubic region to depict the urinary bladder and rectouterine or retrovesical pouch, a recess formed by a fold of the peritoneum that descends between the rectum and uterus in women or the rectum and bladder in men.

This recess is called the pouch of Douglas. Like the Morison pouch, it is a space in which free intraperitoneal fluid may collect.

Extended FAST (EFAST) includes assessment of the thorax for haemothorax and pneumothorax

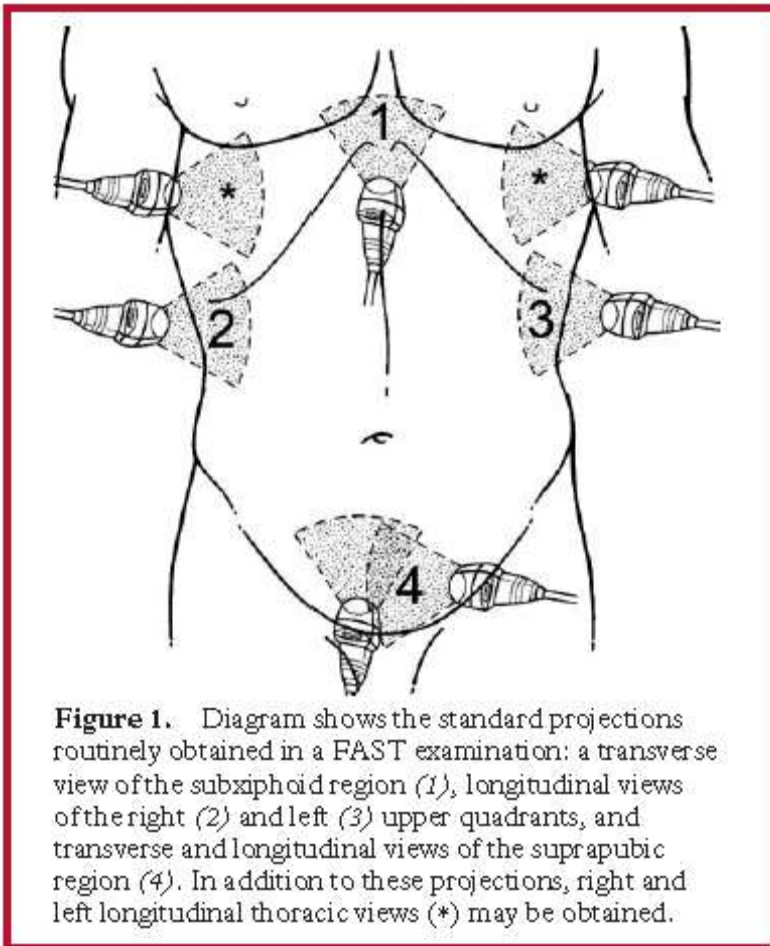


Figure 2: Showing standard projections routinely obtained in FAST

In the evaluation of trauma patients both FAST and EFAST should be performed to identifying presence of free fluid and should swiftly be done not taking not more than 5 minutes when hemorrhage is suspected.

It was only in the 1990s that sonography became widely advocated for the screening evaluation of patients with BAT in the USA

Most recently, the FAST has been included as part of the advanced trauma life support course. The FAST examination has virtually replaced DPL as the procedure of choice in the evaluation of hemodynamically unstable trauma patients with a sensitivity of FAST scan is 98% and specificity 95

%. (41-42)

2.3 Learning curve for performing FAST

FAST can be performed by surgeons as well as radiologists with equal reliability.^(17, 43-44) It is for this reason that FAST is an examination that can be performed by clinicians in the emergency department, even after hours when radiology staff are not immediately available. The exact amount of training required to be able to perform the FAST is a question that remains to be clearly answered. It is a controversial area and many people have a vested interest, and consequently recommendations range from a brief course and 10 supervised scans to 3 years' training and more than 500 scans. For a simple FAST examination, there is a learning curve that is relatively steep for the first 25–50 scans with a relatively rapid improvement in sensitivity throughout this period, then continues to improve slowly to 200 scans then reaches a plateau.⁽⁴⁵⁻⁴⁷⁾

The training should include; A course with theoretical and practical components, supervised scans and exposure to adequate number and variety of positive scans.

2.4 Sensitivity and specificity of FAST

In the majority of studies, the sensitivity of FAST for detection of free intraperitoneal fluid was (0.64–0.98) while the specificity of FAST was high, at 0.86–1.00.^(13, 17-19, 48-49) These widely ranging results may be explained by differences in the levels of experience among observers (dedicated sonographers, radiologists, surgeons, and residents) and in the reference standards used.

The detectability of free fluid during the FAST examination is strongly dependent on the volume of fluid present. Branney et al found a minimum detectable fluid volume of about 200 mls with fluid above 100mls being pathological.⁽⁵⁰⁾

The role of FAST in the diagnosis of specific injuries to solid organs is limited secondary to the difficulties of screening visceral organs with this technique with reported sensitivity of ranges from 0.44 to 0.95, with high specificity of 0.4–1.00.⁽³³⁻³⁵⁾

2.5 Free Fluid Scoring Systems

Hemoperitoneum following trauma is not necessarily an indication for immediate laparotomy. Although, US can demonstrate the extent of hemoperitoneum, but this information to the surgeon has been limited to the use of words such as "mild," "moderate," or "massive" to describe fluid volume. clinical decision rules and scoring systems have become increasingly popular for their use in point-of-care decision-making in many clinical situations⁽⁵¹⁻⁵²⁾ with development of clinical decision rules that are accurate, practical, easy to apply, and derived from information that is readily available to the clinician.

To improve this insufficient information and assist the surgeon in decision making, in 1994, a scoring system for fluid quantification was developed at the Department of Radiology, Duke University Medical Center⁽⁵³⁾.

On US, the depth of the largest fluid collection is measured from anterior to posterior in centimeters and each additional site where fluid is present is given one point. The patient's hemoperitoneum score is calculated by adding the depth of the largest collection and the total number of points assigned to all the additional sites that demonstrate fluid (In small, curvilinear collections; the width of fluid is determined).

Quantifying free fluid during the early stages of assessment may improve patient selection for laparotomy.

Huang et al(54) developed another scoring system. They based criteria on locating pockets of fluid with a thickness of 2 mm or greater. Each region or pocket of fluid 2 mm or greater received a score of 1. Patients with 3 pockets, or a score of 3 or greater were taken to the operating room.

Other scoring systems were also developed at different trauma centers to improve the patient selection for laparotomy in patients with BAT.⁽⁵⁵⁾

Most previously developed decision rules use FAST findings with or without hypotension to predict the need for laparotomy. A hemoperitoneum score developed by McKenney et al⁽²²⁾, combined the depth of the largest fluid collection with the number of sites of free intraperitoneal fluid. Based on their scoring system, 87% of patients with an US score ≥ 3 and all patients with hypotension (defined as SBP ≤ 90 mm Hg) and an US score ≥ 3 required a therapeutic laparotomy. Thirty-eight percent of their patients with scores of < 3 and hypotension still required laparotomy compared with only 4% of patients who were normotensive with a score < 3 . However, their study was limited in that they only included patients with sonograms positive for free fluid, so predictions regarding patients who had negative sonograms could not be made. Huang, et al. developed “A Simple Scoring System” for the evaluation of hemoperitoneum with ultrasonography based on free intra-abdominal fluid seen at specific sites. In their study, 96% of patients with an US score ≥ 3 required therapeutic laparotomy. While both of these studies showed that FAST findings can be used to help predict the overall probability that a given patient will require laparotomy, neither scoring system has been widely incorporated into practice. This is due in large part to the difficulty of applying broad percentages to individual patients, to the poor negative predictive values, and partly due to the complexity of their scoring system.

In a study by Moylan et al⁽⁵⁶⁾, it has been demonstrated that there is a strong association between a positive ED FAST exam and therapeutic laparotomy in normotensive blunt trauma patients. In their study, 37% of normotensive patients (defined as SBP > 100 mm Hg) with a positive FAST exam required a therapeutic laparotomy versus 0.5% with a negative FAST exam. Their study excluded patients who were hypotensive during the initial ED evaluation.

On this basis Manka et al⁽⁵⁷⁾ have developed a scoring system that incorporates FAST examination findings and vital signs of pulse and SBP referred to as Sonographic scoring for operating room triage in trauma (SSORTT score).

In their study, a positive FAST exam was the single best predictor of laparotomy, but adding SBP and pulse strengthened the correlation. Their scoring system is simple and uses variables that are immediately and dependably available, as well as highly correlated with the need for surgery.

See Appendix V for SSORTT score .

Sonographic Scoring for Operating Room Triage in Trauma (SSORTT score) was developed at Erie County Medical Center, Department of Emergency Medicine, Buffalo, NY a Level I Trauma Center with an annual emergency department (ED) census of 52,000.

With analysis of trauma records it was established that the three most common parameters that determine need for therapeutic laparotomy among BAT patients were FAST findings, systolic blood pressure and pulse rate. Once the associated variables were identified, multiple logistic models with stepwise selection procedures were tested using progressive cutoff points. Choice of the cutoff values was based on these models, as well as physiologic parameters that represent class III hemorrhagic shock [pulse > 120 beats/minute and systolic blood pressure (SBP) < 90 mm Hg]. From these models a simplified score was developed that used the combined variables associated with which subjects would not have urgent laparotomy.

This study was designed to determine which patients would less likely require therapeutic laparotomy however the reverse is also true: It can predict those who would need a therapeutic laparotomy hence limiting delay.

This study seeks to determine the diagnostic accuracy of SSORTT score in BAT patients using the standard of care as the reference standard at Mulago Hospital.

Table 1: Summary of studies on Hemoperitoneum:

Author /year	Country /setting	Sample size	Design	Conclusion
<i>Huang;et al 1994</i>	USA / Hospital based	49	Prospective study	US Scan use avoids unnecessary laparotomy .Scores ≥ 3 predict need for surgery.
<i>Kimberley L. McKenney,et al 2001</i>	USA, Hospital based	100	Prospective study	US hemoperitoneum Scoring system predicts therapeutic laparotomy .Scores ≥ 3 predict need for surgery.
<i>Adrian W. Ong, MD, Mark G. McKenney,et al 2003</i>	USA, Hospital based <15 years	193	Retrospective study	Hemoperitoneum score useful adjunct to traditional clinical parameters in predicting the need for subsequent laparotomy in pediatric patients.
<i>O. John Ma, * Michael P. Kefer et al 2001;</i>	USA, Hospital based	270	Prospective study	Hemoperitoneum & unstable vital signs, are sensitive for determining the need for exploratory laparotomy in patients with BAT
<i>Manka, Michael Jr et al. 2010</i>	USA, Hospital based	1,393	Retrospective study	SSORTT score, patients with a Score of 0 or 1 had a less than 1% chance of requiring laparotomy. This derivation set must be validated

2.6 BAT in Mulago:

Studies done in Mulago reported that blunt abdominal trauma occurs in more than half of patients presenting with abdominal injuries and that morbidity increases with multiple organ injuries. Spleen was the most injured organ in BAT (58.7%), abdominal wall 10.7%, liver 8.7% I the bladder 8.7% and large bowel 45%.^(4, 6)

Missed intra abdominal injuries in BAT (ruptured spleen, ruptured liver, perforated colon, etc) accounted for 29.5% of preventable deaths in major trauma patients.⁽²⁵⁾

Mortality rate of 21.7% for abdominal injuries generally.⁽⁶⁾

Trends in pattern injuries in BAT are changing and the need to embrace better screening tools to quickly make decision that are lifesaving is important.⁽⁵⁸⁾

2.7 CT Scan:

CT scan is indicated in BAT in haemodynamically stable patients with equivocal findings on physical examination, neurological injury or impaired sensorium due to drugs or alcohol, multiple extra-abdominal injuries⁽⁵⁹⁾, and when the mechanism of injury is suggestive of duodenal or pancreatic injury⁽⁶⁰⁾.

CT scan is contraindicated in BAT patients with clear indication of laparotomy and in haemodynamically unstable patients.

CT scan has a high accuracy reaching about 95% and a very high negative predictive value reaching almost 100%⁽⁵⁹⁾. Despite that, patients with suspected abdominal injury should be admitted for at least 24 hours in the hospital for observation even with a negative CT scan result. CT provides a detailed image of injuries. Finding free intraperitoneal air or rupture diaphragm are definite indications for laparotomy. It is very useful in defining the severity of solid organ injury and guiding the non operative management and decisions for surgery.

Helical CT with contrast enhancement can detect arterial extravasations (contrast blush) in BAT patients. This can be used to localize the anatomical sites of injury and to guide angiographic or surgical intervention⁽⁶¹⁾. Follow up CT scan is useful to help making clinical decisions when adopting a conservative approach.

CHAPTER THREE

3.0 Methodology:

3.1 Study design

Prospective observational cohort study was carried out for four months in the Accidents and Emergency Unit from December 2012 to April 2013. Patients meeting the eligibility criteria were recruited and informed consent obtained. For those who were hypotensive and those with impaired consciousness a waiver for written consent obtained from the IRB to enroll them and subject them to the SSORTT score. Management of all patients followed ATLS protocol. All patients were adequately resuscitated and investigated as per the standard of care. Patients were then followed up for 3 days to determine who received laparotomy.

3.2 Study setting

The study was conducted in the A and E department of Mulago National referral hospital situated in Kampala. This is a fully fledged unit with medical and a surgical emergency wing, two operating rooms, an x ray facility, ultra sound facility, resuscitation room with 3 beds, and a 26-bed holding emergency ward, adjacent to it are the blood bank, hematology, microbiology and chemistry laboratories.

The A and E department is open 24hrs a day and is headed by a consultant surgeon, who leads a team of surgical residents trainees, medical officers and paramedics, nurses, support staff and volunteers. It's the emergency unit that serves the National Referral Hospital receiving majority of the trauma patients admitted.

On arrival in the A and E department, trauma patients are triaged and transferred to the examination rooms where they are immediately attended by doctors; who plan management after history and examination; resuscitation takes precedence over the above protocol. Patients for operative management are immediately taken to the adjacent casualty operating theatre while those for observation and further investigations are admitted to emergency holding (surgical) ward for 24hrs

before onward transfer to the admitting firm or one of the specialized units. It receives about 1500 trauma patients per month 300 with suspected torso injury and about 20 with actual torso injury according to A&E records.

3.3 Study participants:

3.3.1 Target population

All Blunt abdominal trauma patients in Uganda

3.3.2 Accessible population

All blunt abdominal trauma patients at Mulago Hospital Accidents and Emergency department during study period.

3.3.3 Study population

All patients with blunt abdominal trauma at the Mulago Hospital Accident and Emergency department during the study period meeting the eligibility criteria.

3.4 Eligibility Criteria:

3.4.1 Inclusion Criteria

Patients above 12 years presenting at A &E with BAT in whom the clinician suspects internal injury including;

- Chest and abdominal pain
- Torso abrasions and bruises
- Multiply injured patients
- Unconscious patients
- Suspected substance abuse e.g. alcohol
- Long bone fractures
- Fracture pelvis
- Spine injuries

3.4.2 Exclusion Criteria

-Subcutaneous emphysema over the abdomen because it abdominal assessment with sonography difficult.

3.5 Sampling methods:

Consecutive sampling

3.6 Sample size estimation

Calculated using formula for determining sample size for descriptive study of a dichotomous variable.(62)

$$N = 4Z_{\alpha}^2 P (1-P) \div W^2$$

Definition;

N = Total number of subjects required

P = Expected proportion (which was 26.1% with BAT and required therapeutic laparotomy)⁽⁶³⁾

W = Total width of confidence interval (set at 0.10 for this study)

Z_α = The Standard Normal deviation = 1.96

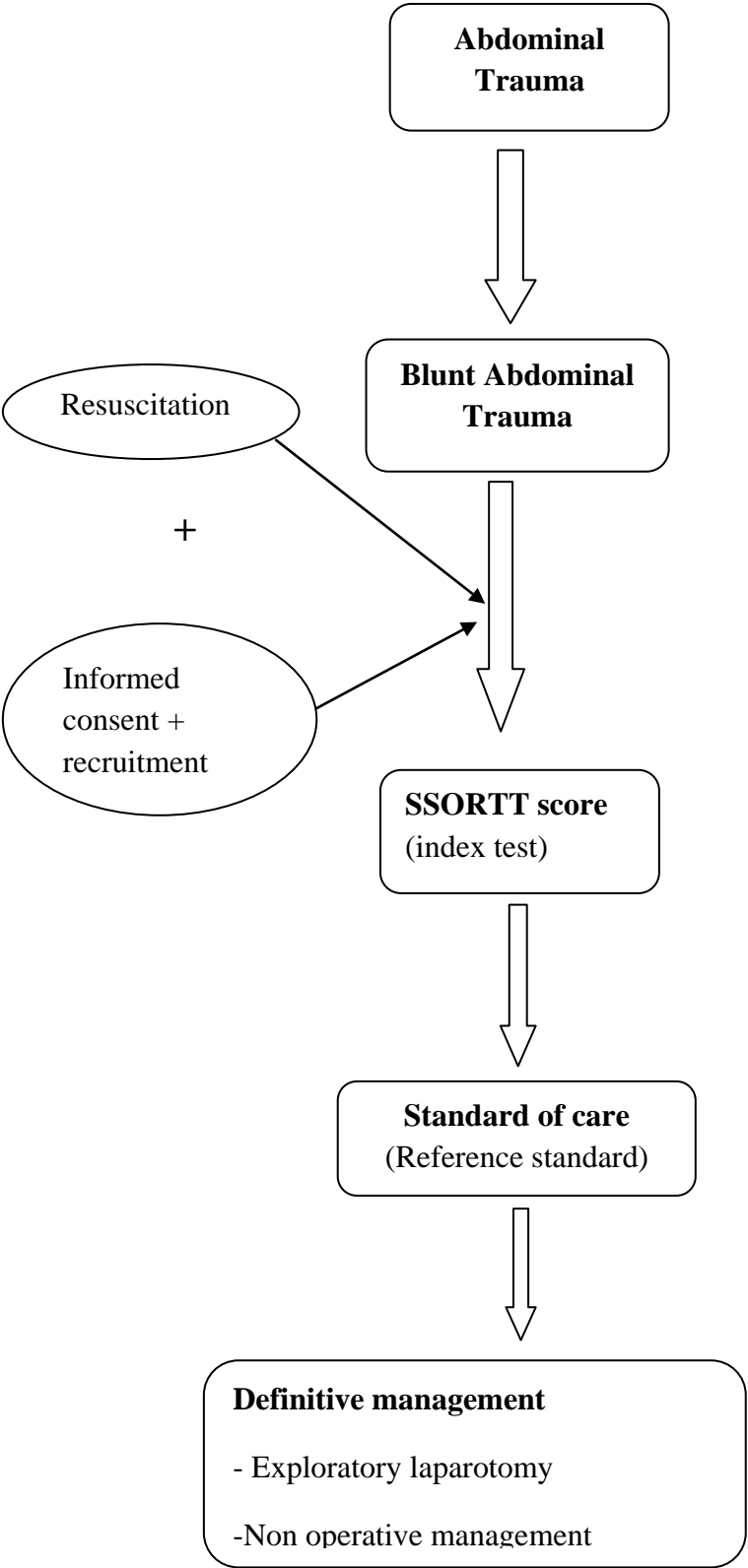
$$\alpha = 0.05$$

Confidence level set at 95%

$$N = \frac{4*(1.96)^2 * 0.261(1-0.261)}{0.10^2}$$

$$N = 210 \text{ participants}$$

Figure 3: Patient flow chart



3.7 Procedure

Upon arrival, eligible patients were identified in the A&E, i.e. patient with suspected BAT defined as injury to intra abdominal viscera or retroperitoneal as a result of a non penetrating object or force indicated by presence of torso abrasions and bruises, abdominal tenderness among multiply injured patients with long bone fractures, fracture pelvis and Spine injuries was done.

Assessment was done using ATLS protocol .A primary survey assessing Airway and C-spine stabilization, Breathing and ventilation ,Circulation, Neurologic disability and exposure .All patients requiring resuscitation were resuscitated appropriately .

During resuscitation the eligible patients were enrolled and informed consent was obtained. A special request was obtained from the IRB for a waiver of consent in case of unconscious patients without relatives as well as for hypotensive patients. Patients meeting the inclusion were recruited consecutively. History and physical examination findings were recorded on coded questionnaires. Patients suspected to be having BAT were positioned in supine position and underwent FAST using SonoSite TITAN® portable ultrasound machine with a transducer frequency ranging from 3.5-5MHz. The examinations were performed by the principal investigator. Images were saved to be reread by a radiologist as a quality control measure. A cumulative sum of the three parameters ultrasound score, systolic blood pressure and pulse rate were determined and used as the SSORTT score.

Patient then underwent secondary survey which was followed by other routine investigations and management according to the hospital guidelines. Patients were sent to the emergency radiology room for a full ultrasound scan and abdominal x-ray that were performed by radiographers on duty. While admitted patients were followed up for three days to determine whether they had laparotomy or not.

3.8 Study variables

3.8.1 Independent variables:

- SSORTT score
- Age
- Sex
- Mechanism of injury e.g. RTA,

3.8.2 Dependent variables:

- Therapeutic laparotomy
- Non therapeutic laparotomy
- Outcomes of Non Operative Management Live/die, any complications during hospitalization.

3.9 Data Collection and management

Data was collected using pretested questionnaires and data entry forms by the principal investigator and the research assistants. Data collected was double entered, coded and cleaned using Epi data version 5.3.2 software package by the PI with the help of a statistician. The data was saved on a hard drive and backed-up on the internet as well as a flash disc and kept safe by the PI, while the questionnaires are kept under lock and key to ensure safety, confidentiality and avoidance of loss of information.

3.10 Quality control

The PI underwent didactic tutorial on FAST from the Department of radiology and also performed at least 30 ultrasound scans to determine presence of hemoperitoneum.

The PI worked with the research assistants in data collection.

Research assistants were trained by the PI before data collection date commenced. The PI revised data collected each day and carried out information clean up.

The ultrasound machine was maintained and calibrated by MNRH staff from the department of radiology. The examinations were done by the PI and images (sonographs) stored and reread by a radiologist to confirm or rule out the FAST diagnosis and also provide the ultrasound score by consensus.

3.11 Data analysis

Stored data was exported to stata version 12 for analysis.

Objective: Accuracy of the SSORTT Score in predicting patients that would need therapeutic laparotomy was determined by calculating sensitivity, specificity, PPV, NPV and ROC curve of SSORTT score. At each cutoff of SSORTT score determined sensitivity, specificity, and predictive value in predicting laparotomy. Accuracy of the Standard of care (SOC) (i.e. clinician's decision whether or not to operate) in predicting therapeutic laparotomy using sensitivity, specificity and predictive value.

ROC curve used to determine diagnostic accuracy of SSORTT score for predicting the need for therapeutic laparotomy.

3.12 Role of principal investigator

The principal investigator participated in the resuscitation of patients with suspected blunt abdominal trauma and assessed for eligibility criteria and then scored patients with SSORTT score and also administered questionnaire and later followed up of patients to determine their outcome.

PI also participated in performing emergent surgical procedures e.g. laparotomy and tube thoracotomies to help preserve life.

3.13 Ethical considerations

Written Informed consent for patients above 18 years and assent for those less than 18 years was obtained from the participants. Special permission was obtained from IRB to study the patients who were unable to consent because of unconscious state and having no attendants around. Appropriate ethical approval was sought from the Department of Surgery, Research and Ethics Committee of the

College of health Sciences of Makerere University and Mulago hospital management. Confidentiality and treatment to participants with other problems was offered.

3.14 Dissemination of results

Department of Surgery Mulago Hospital, School of Graduate Studies MakCHS, Sir Albert Cook library, publish in reputable peer reviewed journals.

3.15 Study limitations:

1. Ultrasound has limited sensitivity for determining specific organ injury retroperitoneal injuries , one patient had a non therapeutic laparotomy as organ injury wasn't picked by ultrasound whose sensitivity for specific organ injury is low.
2. In the calculation of the SSORTT score ,ideally blood pressure and pulse rate should be calculated at the beginning of resuscitation however often blood pressures and pulse rate would be taken after fluids were put up to resuscitate patients and in some situation it would be assumed to influence the SSORTT score . However this didn't influence the observed result markedly .
3. Post mortem findings to determine cause of death were not done for various reasons like attendants declining diagnostic postmortem or it wasn't done .

CHAPTER FOUR

4.0 RESULTS

4.1 Study profile

Total of 195 trauma patients clinically suspected to have sustained BAT were subjected to the SSORTT Score at the A&E unit of Mulago Hospital from 20th December 2012 to 20th April 2013.(4 months).

Figure 4: Study profile

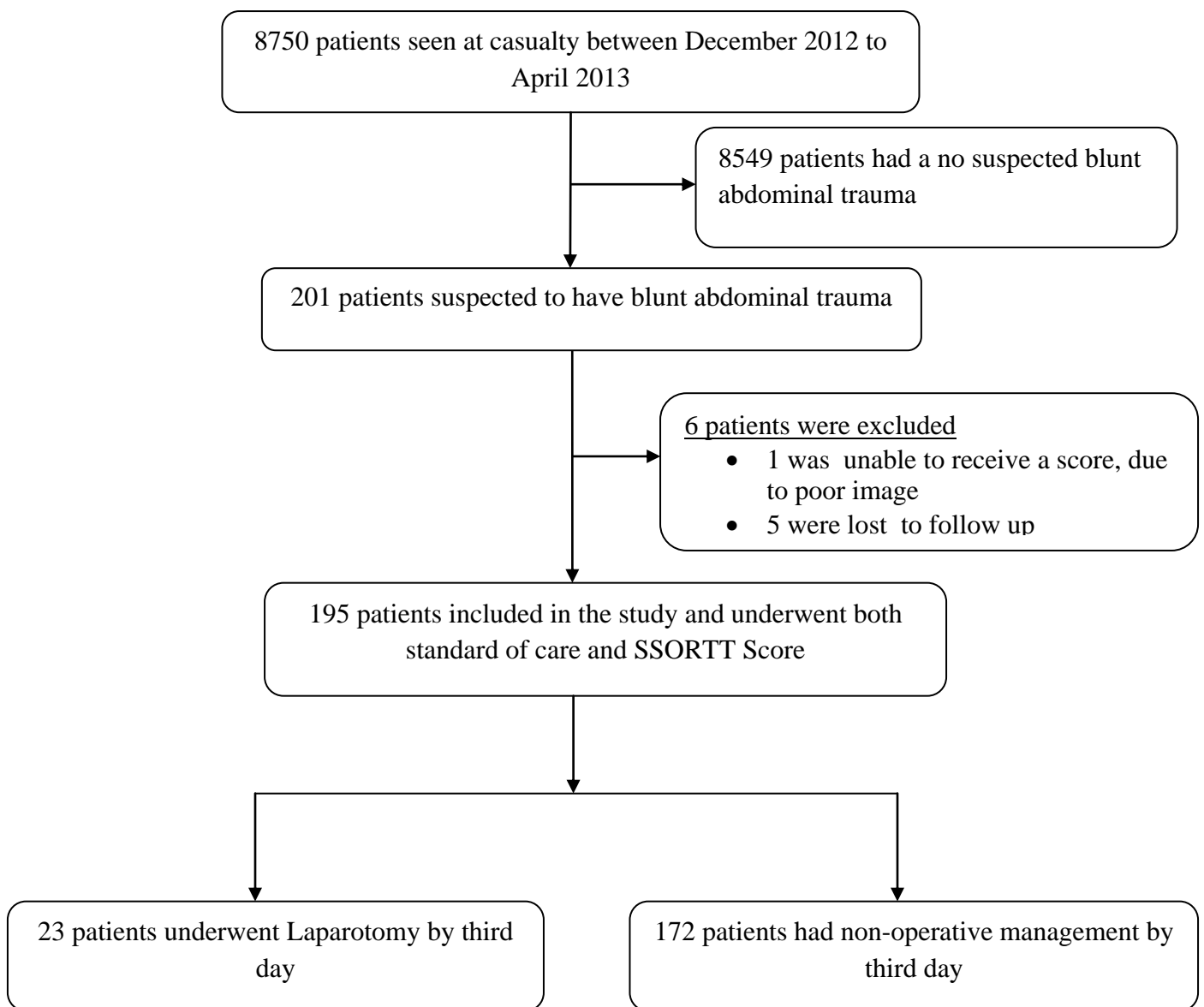


Table 2: Distribution of baseline characteristics

Characteristic	Study Participant distribution N= 195	
	Number	Percentage
Age groups		
<20	22	11
20-40	153	79
41-60	18	9
>60	2	1
Gender		
Male	168	86
Female	27	14
Time since injury in hours*		
<1	20	10
1-2	84	43
>2	73	37
Unknown	18	10
Mechanism of injury*		
Road traffic crash	116	59
Assault	62	32
Fall	13	6
Others	4	2

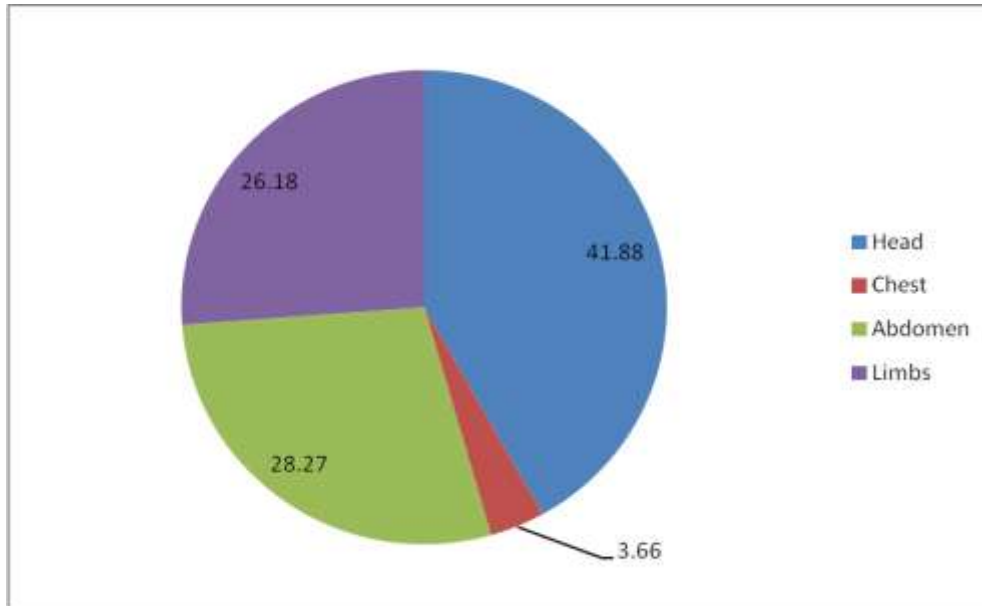
A total of 168males (86%) and 27females (14%) were enrolled, Male: Female ratio was 6:1.

Age group between 20-40 years comprised majority of patients 153(79%)

Majority of patients 84(43%) arrived at A&E between 1- 2 hours, 73 patients (37%) arrived after 2 hours.

Road traffic crash (RTC) was the leading cause of injury in this study accounting for 59%.Others causes included Assault 32%, falls 7% and others 2%.

Figure 5: Distribution of external injuries:



Most of patients with BAT had clinically suffered injuries to head, abdomen or limbs

Table 3: Clinical abdominal findings

	Number	Percentage
Abdominal distension		
Yes	28	14
No	166	86
Movement with respiration		
Yes	189	97
No	5	3
Guarding		
Yes	26	13
No	168	87
Tenderness		
Yes	52	27
No	142	73
Shifting dullness		
Yes	21	11
No	173	89
Bowel sounds		
Yes	184	95
No	10	5

Abdominal tenderness was the commonest symptom among BAT patients

Table 4: Distribution of SSORTT score by intervention

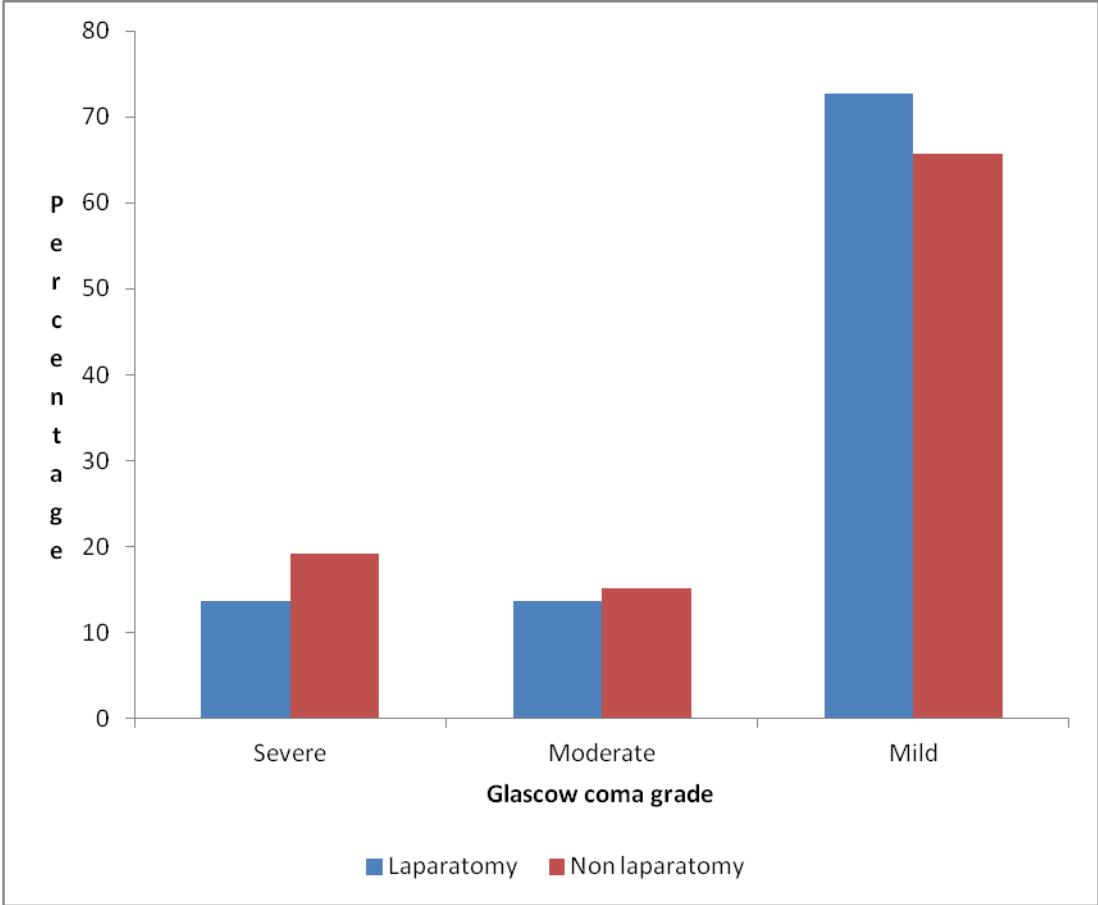
SSORTT score	Laparotomy	No laparotomy	Total
	Total=23	Total=172	N=195
	Number (%)	Number (%)	Number (%)
0	2(9)	142(83)	144(74)
1	0	13(8)	13(7)
2	1(4)	1(1)	2(1)
3	5(22) *	12(7)	17(9)
4	6(26)	3(2)	9(5)
5	3(13)	1(1)	4(2)
6	6(26) *	0(0)	6(3)

* 2 participants had non therapeutic laparotomy with scores of 3 and 6.

20/23 (86%) patients who had therapeutic laparotomy had SSORTT score ≥ 3

156/173(90%) patients who had non operative management had SSORTT score ≤ 2

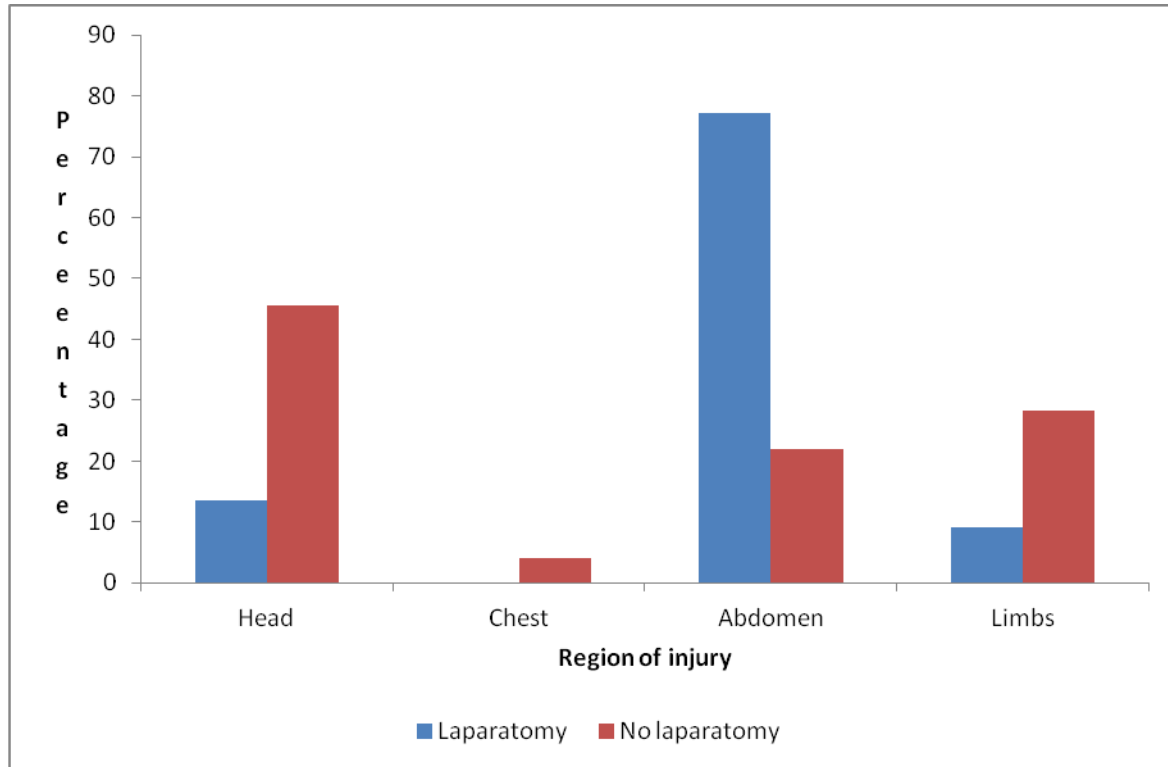
Figure 6: Distribution of Glasgow coma score with laparotomy



Majority of patients that had laparotomy had mild impairment in their Glasgow coma score

Only small proportion had Glasgow coma score < 13.

Figure 7: Distribution of laparotomy with region of injury



>80% of Patients with tell tale signs of abdominal trauma and head injury were subjected to laparotomy

Majority of the patients with head injury were subjected to non operative management

Table 5: Surgical management findings:

	Number	Percentage%
Therapeutic laparotomy		
Massive hemoperitoneum	16	47
Grade4/5 Solid organs injury	12	35
Gut perforation	2	6
Mesenteric tears	1	3
Bladder injury	1	3
Other		
Non therapeutic laparotomy		
Retroperitoneal hematoma	1	3
<Grade3 Solid organs injury	1	3

Among therapeutic laparotomy patients, massive hemoperitoneum was the commonest finding at 47%, followed by solid organ injury at 35%, **gut** perforation at 6%.

Among non therapeutic laparotomy retroperitoneal hematoma and <Grade3 Solid organs injury were findings.

Table 6: Laparotomy predictions at selected cut offs

SSORTT score	Standard of care		Sensitivity	Specificity	PPV (%)	NPV (%)
	Laparotomy	No laparotomy				
Selected score cut offs						
At 0						
Laparotomy	19	30				
No laparotomy	2	142	91	82	39	99
≤ 1						
Laparotomy	19	17				
No laparotomy	2	155	90	90	53	99
≤ 2						
Laparotomy	18	16				
No laparotomy	3	156	86	91	53	98
≤ 3						
Laparotomy	14	4				
No laparotomy	8	168	67	98	78	96
≤ 4						
Laparotomy	8	1				
No laparotomy	14	171	38	99	89	93
≤ 5						
Laparotomy	5	0				
No laparotomy	17	172	24	100	100	91
At 6						
Laparotomy	0	0				
No laparotomy	22	172	0	100	0	87

Generally the sensitivity at the various cut off levels of the SSORTT score reduces

Values of specificity gradually increase

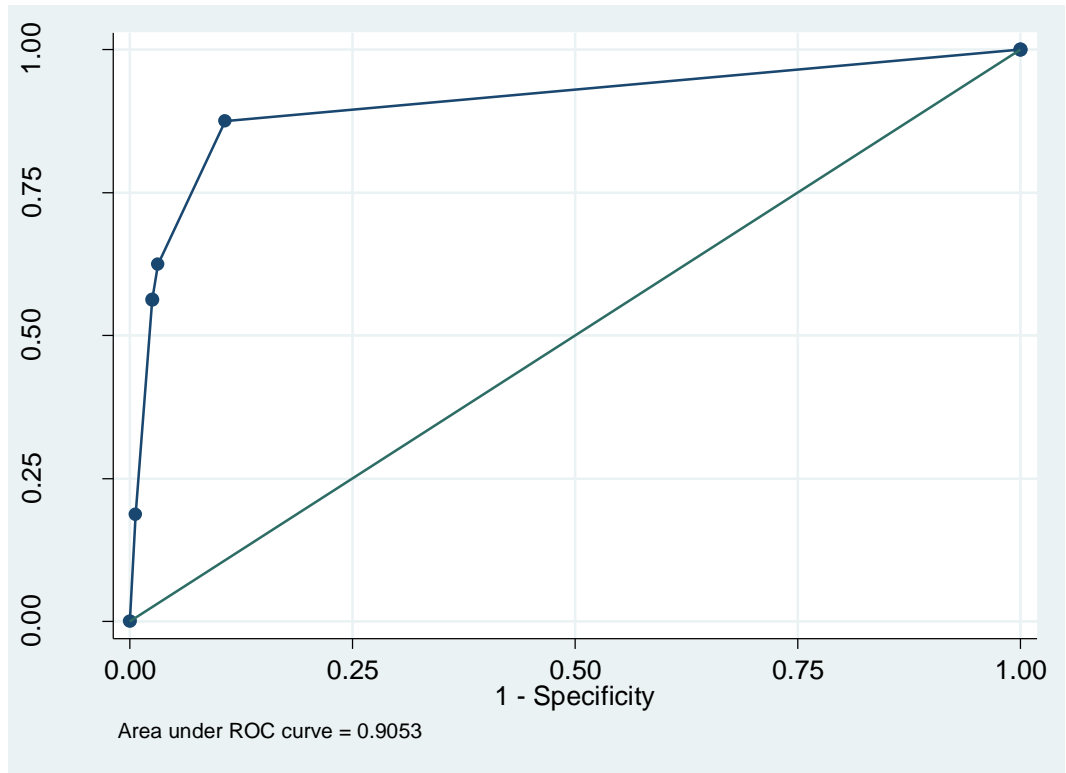
At SSORTT score 0, sensitivity = 91% and specificity = 82%

At SSORTT score 6, sensitivity = 0% and specificity = 100%

At SSORTT score 0, PPV = 39% and NPV = 99%

At SSORTT score 6, PPV = 0% and NPV = 89%

Figure 8: ROC Curve for SSORTT score



Accuracy

.90-1 = excellent (A)

.80-.90 = good (B)

.70-.80 = fair (C)

.60-.70 = poor (D)

.50-.60 = fail (F)

Accuracy is measured by the area under the ROC curve.

The closer the curve follows the left-hand border and then the top border of the ROC space, the more accurate the test

Area under ROC curve = 0.9053 meaning that the accuracy of SSORTT score is excellent

Table 7: Distribution of injuries in relation to death - 33 patients died

Injuries	Patient status		OR(95%CI)	p-value
	Alive Number (%)	Died Number (%)		
Nil				
Yes	21(13)	1(3)	4.9	0.129
No	138(87)	32(97)	(0.63-37.54)	
Bruises				
Yes	66(47)	21(66)	0.47	0.063
No	74(53)	11(34)	(0.21-1.04)	
Abrasions				
Yes	30(21)	8(25)	0.82	0.661
No	110(79)	24(75)	(0.33-2.00)	
Lacerations				
Yes	79(56)	18(56)	1.00	0.985
No	61(44)	14(44)	(0.46-2.18)	
Cuts				
Yes	10(7.14)	3(9)	0.74	0.667
No	130(92.86)	29(91)	(0.19-2.87)	
Burns				
Yes	2(1)	1(3)	0.45	0.519
No	138(99)	31(97)	(0.04-5.11)	
Abdominal				
Yes	43(30)	7(22)	1.57	0.334
No	98(70)	25(78)	(0.63-3.90)	
Chest				
Yes	16(11.35)	6(19)	0.55	0.262
No	125(88.65)	26(81)	(0.20-1.55)	
Others				
Yes	120(86)	23(74.19)	2.20	0.100
No	19(14)	8(25.81)	(0.86-5.62)	
Standard of care				
Laparotomy	17(10.69)	6(18.18)	1.64	0.370
No laparotomy	142(89.31)	27(81.82)	(0.56-4.86)	

Patients with no external injuries were more likely to die OR 4.9 though not clinically significant

Patients with bruises , abrasions, Lacerations, Cuts,were less likely to die, not clinically significant

Patients with Abdominal injuries were more likely to die OR 1.57, not clinically significant

Patients with Chest injuries were less likely to die OR 0.55, not clinically significant

Patients with other injuries were more likely to die OR 2.20, not clinically significant

Patients who had laparotomy were less likely to die OR 1.64, not clinically significant

Table 8: Distribution of SSORTT Score with death

SSORTT score	Alive	Death
0	126	18
1	10	3
2	2	0
3	11	6
4	8	1
5	3	1
6	2	4
	162	33

Majority of patients that died had a SSORTT score of 0 (54.5%)

Table 9: Distribution of Glasgow coma score with death.

	Alive	Died
Severe	15	21
Moderate	22	9
Mild	125	3
	162	33

Majority of deaths were in the severely deranged GCS i.e. 3-8

Table 10: Distribution of intraperitoneal fluid with death

	Alive	Dead
Present	29	7
Absent	133	26
	162	33

7 patients with intrabdominal fluid died.

Table 11: Distribution of SSORTT score among patients with intraabdominal fluid that died

SSORTT score	Frequency	Percentage
3	2	28.6
4	1	16.7
5	1	16.7
6	3	42.9
	7	100

All patients that passed away with intra abdominal fluid had scores of > 2

CHAPTER FIVE

5.0 DISCUSSION

This study set out to determine the diagnostic accuracy of the SSORTT score a sum of the Ultrasound score, systolic blood pressure and pulse rate based on values of grade 3 shock. It works on the principle of combining a hemoperitoneum score with physiologic parameters of blood pressure and pulse rate.

This study found SSORTT score had excellent diagnostic accuracy for identifying patients that needed therapeutic laparotomy at SSORTT scores greater than 1. Excellent diagnostic accuracy is defined as accuracy above 90%. (Figure 7)

5.1 Diagnostic accuracy of SSORTT score

Major findings of the study were that sensitivity of the SSORTT score reduces from 91% at 0, to 0 at SSORTT score of 6. Specificity gradually increased from 82% at 0 and increased to a maximum 100% at SSORTT score of 6. At the cutoff of SSORTT ≤ 1 it was found that it had the highest sensitivity and specificity and correctly identified 19 patients of the 21 patients that had therapeutic laparotomy. At this score the positive predictive value was 53% and negative predictive value was 99%. Using a ROC curve, accuracy of SSORTT score was determined from Area under ROC curve = 0.9053 meaning that the accuracy of SSORTT score is excellent. (Figure7). The findings of this study are comparable to findings of another study done by Manka (2010) where he concluded that patients with score of 1 or 0, were less likely to require laparotomy. ⁽⁵⁷⁾With sensitivity and specificity of 0.892 and 0.700 respectively and positive predictive value of 0.990 and accuracy of 0.852. The sensitivity and specificity of the previous study were lower than findings in current study and possible explanation could be differences in sample size of this study. A smaller sample of 195 patients in this study compared to the 1,393 patients in the previous study hence the higher sensitivity, specificity and accuracy of SSORTT score

Methodology of study was the same, both were prospective studies and either post-graduate year 3 emergency medicine (EM) residents or EM attendings trained in bedside ultrasound performed FAST

exam of patients to give ultrasound sound score compared to our study were ultrasound score was determined by PI. a third year Senior House Officer who had received training in focused assessment with sonography for trauma (FAST). Had scanned thirty patients with intra abdominal fluid. To ensure quality of interpretation of the sonograms, saved images were reviewed by a consultant radiologist and the ultrasound score determined blinded from the patient's condition.

As shown in the evidence SSORTT score had excellent diagnostic accuracy in our setting though the sample used was smaller than found in a previous study. Because of the increasing trauma burden in our country ^(10, 64-65) use of devices like portable ultrasound stationed in the emergency room and emphasis on skills training in to emergency room staff on identification of life threatening injuries early like intrabdominal hemorrhage, hemothorax or hemoperitoneum will help reduce delays in decision making.

5.2 Sex and Age distribution:

More males 168(86%) and 27(14%) females were enrolled in this study. (Figure 1)The male: female ratio was 6:1 with the age group between 20-40 years comprising majority of patients 153(79%).Generally youths were in the age group which was more affected mainly because they are active and productive worldwide hence their exposure to injury. Studies done in the region and Mulago also had similar findings ^(8, 63, 66)

5.3 Mode of Injury

Road traffic accidents (RTA) were the leading cause of injury in this study accounting for 60%.Others causes included Assault 32%, falls 7% and others 1%. Among RTAs, motorcycle accidents accounted for 62% of injuries, private cars 21%, buses and taxi s 8%.Majority involved injury to the rider. Studies done in the region showed RTAs are leading cause blunt abdominal trauma^(65-7,11),there was noted high proportion of patients with injuries due to motorcycle injuries and studies done by Galukande ⁽¹¹⁾Andrew⁽¹⁰⁾ reported an increase in boda bodas injuries following road traffic injuries associated with significant economic burden.

5.3 Duration from time of injury to admission

Majority of patients 84(48%) arrived at A&E between 1 and 2 hours, 76 patients (41%) arrived after 2 hours. This finding is contrary to findings other studies which report that majority of patients report within the first hour.⁽⁶⁷⁾ This was found to apply more to patient whose district of origin was Kampala and Wakiso. Most of patient who came from more peripheral districts more than 50 km arrived at MNRH by the second day. Lack of an effective ambulance system to transport injured patients to hospital could explain why majority of patients reached hospital more than an hour following injury.

5.4 Clinical assessment:

In this study, head injuries were the commonest injury pattern at 80 patients (42%), followed by abdominal injuries at 54 patients (28%).Others were limb extremity injuries at 50 patients (26%) and chest injuries at 7 patients (4%).

Head injury was a common injury mainly because patients with trauma to the head and impaired mentation were part of inclusion criteria. Among the abdominal injuries, the commonest symptom related to laparotomy was abdominal tenderness. It accounted for 27% followed by abdominal distension at14% and guarding at 13%.Majority of the patients had a GCS between 9-13 (66%).Many studies have demonstrated that physical examinations are unreliable in trauma patient cohorts with neurological injury (brain or spinal cord), in those with painful distracting injuries such as long bone or pelvic fractures, or in those with alcohol or other intoxicants in their systems.⁽²³⁻²⁴⁾

5.5 Patient management:

Of the 195 patients with suspected blunt abdominal trauma 23(12%) patients had laparotomy and the rest managed non operatively based on the Standard of care (SOC). In this study, majority of the patients 172(88 %) didn't require laparotomy.23 patients (12%) received laparotomy and of these 21 were therapeutic i.e. surgically correctable lesion. Massive hemoperitoneum with solid organ injury were the commonest findings at laparotomy with ruptured spleen being the commonest solid organ

injured followed by liver lacerations. 2 cases of gut perforations, 1 had urinary bladder rupture and 1 with mesenteric tears.

These findings are consistent with many other studies done in Mulago and the region^(63, 68-71)

5.6 Patients Disposition at three days:

Of 23 patients that had laparotomy 21 patients had therapeutic laparotomy and 2 being non therapeutic, one had a moderately large retroperitoneal hematoma and the other had a grade two splenic laceration with a hemoperitoneum of about 500 mls. Of the 172 patients that didn't undergo laparotomy 28 patients passed away and the rest were either discharged or still admitted. Of the 28 patients, 18 patients were multiply injured with severe extrabdominal injuries. This can be shown in Table 8 and 9 where majority of patients i.e. 18 patients that died had SSORTT 0 and 23 patients had Glasgow coma score less than 8 indicating presence of severe extra abdominal injuries.

16 patients didn't have post mortem because the relatives declined diagnostic postmortem. Hemoperitoneum was found in 3 patients and 7 patients had blunt force trauma with extra abdominal injury.

Five patients of the 23 that had laparotomy passed away, mainly due to anesthesia related complications and post operative complications like anemia due to shortage of blood. 3 patients developed cardiac arrest in theatre perioperatively and one recovered but eventually died in ICU. Other 2 patients died as result of anemia due to shortage blood from the blood bank and complications of trauma like coagulopathy. The laparotomy rate in this study was 11% and the mortality rate was 17%. This mortality rate was comparable with other previous studies done in Mulago Hospital^(6,68,11) which were between 10-30%. The major cause of mortality in this study were severe head injury and intraabdominal injury.

CHAPTER SIX

6.0 Conclusions and Recommendations:

6.1 Conclusions:

1. SSORTT score has high diagnostic accuracy for predicting therapeutic laparotomy.
 - a. At cut off scores ≤ 1 , high accuracy for not requiring therapeutic laparotomy.
 - b. At cut off scores > 2 , accuracy for therapeutic laparotomy increases with increase in score.
2. SSORTT score is a non invasive, quick, reproducible, inexpensive test that can be performed easily and reliably.
3. SSORTT score is a reliable tool for predicting patients who will not require therapeutic laparotomy in the assessment of blunt abdominal trauma.

6.2 Recommendations:

1. The A&E unit in Mulago should introduce FAST to aid in the assessment of blunt abdominal trauma victims to screen for hemoperitoneum among suspected BAT patients.
2. Clinicians working in the emergency room should be trained in FAST and certified.
3. All emergency rooms should be equipped with preferably with wall sphygmamometers to enable all clinicians easily calculate the SSORTT score.
4. Patients with a SSORTT score of ≤ 1 have high likelihood of not requiring laparotomy.
5. Further studies to validate this score on a larger population recommended.

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APPENDIX I: INFORMED CONSENT FORM – IN ENGLISH

**DR. PETER MBIDDE MUSIITWA, DEPARTMENT OF SURGERY, MAKERERE
UNIVERSITY COLLEGE OF HEALTH SCIENCES. Tel. 0772-856484/ 0701856484**

Introduction

We are conducting a research on Sonographic Scoring for Operating Room Triage in Trauma (SSORTT) patients on how it can improve provision of health care. All patients will undergo emergency ultrasound scan if they wish so followed other investigations planned by the clinician at the unit. Initial systolic Blood pressure and pulse rate shall be recorded and computed into a score that shall be used to predict which patients would most likely require operation as part of the study.

2. Purpose of the research study

The results of this study shall add to our existing knowledge on the management of blunt abdominal trauma in the Accidents and Emergency department.

3. Procedures

After the initial assessment you will have a brief period of emergence ultrasound scan. Some other investigations like blood pressure and pulse rate will also be obtained from your medical record and used to determine the desired score, SSORTT score.

4. Risks

There are known risks for you to undergo this investigation.

5. Benefits

If injury are detected you will be treated according to the capacity of the hospital.

6. Cost associated with the research study

You will not incur any direct costs as a result of participating in this study.

7. Confidentiality

Information related to you will be treated in strict confidence to the extent provided by law. Your identity will be coded and will not be associated with any published results.

8. Rights as a participant

Your participation in this study is voluntary and you may withdraw from the study at any time if you so wish. Declining to participate in this study shall not jeopardize your medical treatment from Mulago hospital in anyway and shall not affect your relationship with Makerere College of Health Science. Should you at any one time have any queries with this research study especially in regard to your

personal rights, you may contact the Chairman of the Internal Review Board of the Ethics and research Committee of Makerere University College of Health Sciences on **+256772437351**.

Voluntary Consent: I have been informed of the study by Dr Peter Mbidde Musiitwa in the casualty of Mulago National Referral Hospital about emergency ultrasound. I understand that I have been asked to participate in the study on emergency ultrasound scan. I have been informed on the aim of the study and that the information I shall give as well as the examination findings shall be kept strictly confidential. I understand that I shall require other examination which may include another ultrasound scanning according to casualty patient management protocol. My participation is entirely voluntary. There are no risks the study confers to me. I am free to withdraw my consent at any time if I so wish and this will not alter the health care being given to me. I freely agree to participate in the study of Focused Assessment with Sonography for Trauma at Mulago National Referral Hospital.

Signed.....

Next of kin.....Tel. No.....

Witness.....

Investigator Dr Peter Mbidde Musiitwa

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APPENDIX II: OKUNYONYOLA N’OKUKKIRIZA – MU LUGANDA

DR PETER MBIDDE MUSIITWA OKUVA MU KITONGOLE KY’ABASAWO ABALONGOOSA,
MU TENDEKERO LY’ABASAWO ERYA YUNIVASITE Y’EMAKERERE; ESSIMU 0772856485
OBA 0701856484

1. **Okwanjula omulamwa**

Tunoonyeleza ku nkozesebwa ya ka tiivi mu balwadde ababa bagudde ku bubenje ne bafuna obuvune munda mulubuto obuyinza okwetaaga okulongosa, nengeri jekiyinza otuyambamu okwongela okuteleza mu nzijanjabwa yabwe. Abalwadde bonna abeetabyemu bajja kubibwa aka tiivi okumanya engeri jebakosedwamu era bajja nokupimwa pressure nentunuunsi zo mubiiri. Era bajja okwongela nokwekebejebwa nga bulijjo okusinzila ku musawo anabalaba kyanasalawo.

2. **Omugaso gw’okunonyereza kunno**

Ebinaava mu kunonyeleza kunno bijja kwongelako ku kumanya kwaffe abantu abagwa ku bubenje bakosebwa mu ngeri ki mu kitundu kyaffe.

3 **Emitendera**

Buli mulwadde anajja oluvanyuma lwobujanjabwa obusooka ajja kubibwa aka tivii era ne bimukwatako e bilala nga entunusi ne pulesa bijja kupimwa erabikozesebwe okupima ekiggendererwa. Oluvanyuma abalwadde bonna bajja kujanjabibwa mu ngeri eyabulijjo jetujanjabamu abalwade ababa bagude ku bubenje.

4 **Obubenje obuyinza okutukako.**

Okukebelebwa kunno ne ka tivii tekukusako kabenje konna kayinza kossa bulamu bwo.

5 **Ebyokuganyulwa mu kunonyeleza kunno**

Kinno kijja kuyambako okuzula obuvuune nga bukyali nokuyamba abalwade okujanjabibwa nga bukyali kyetusubila nti kiyamba abalwadde okuwonna amangu.

6 **Ebisale**

Tojja galikibwako bisaale byoona byanjawulo olwokuba wetabye mu kunoonyeleza kunno.

7 **Ebyokukuuma ebyama**

Ebikukwatako byoona bijja twalibwa nga bya kyama nga amateeka bwegalagila. Era ebiwandikobyo bijj akubaako namba era amanya go tegajja kulabikila ku bintu byona ebinaba bivude mu kunonyeleza kunno.

8.Eddembe ly'oyo nga omulwadde.

Okwetabakwo mu kunoonyeleza kunno kwa kyeyagalile. Era osoboola okuuvamu mu kiseera kyona kyonawuliila nga wetagga okuvamu. Okugaana okwettaaba mu kunonyeleza kunno tekujja kukosa bujanjabi bwo era tekijja kukyusa mu nkolagana yo nabasawo ba makerere university.

Bwomala nofuunamu okwemulugunya kwona okwekuusa ku kunonyeleza kunno naddala ku bikwata ku ddembe lyo nga omulwadde oli waddembe okubiila ssentebe wa kakiiko akakwasa empiisa mu tendekelo lyaffe erya abasawo ali ku namba y'essimu +256772437351.

Okukiliza nga weyagalidde

Nze ntegezedwa ku kunonyeleza okukolebwa Dr Peter Mbidde Musiitwa mu kazolite y'emulago okwekuusa ku nkozesebwa ya ka tivvi mu balwadde abafuunye obubenje.

Ntegezedwa ku bigendelelwa byokunonyeleza kunno era nekinakozesebwa ebinaavamu. Era ntegedde nti nyinza okweetaaga okwekebejebwa okulala okusinzila ku nzijanjabwa eyabulijjo mu kazolite eno. Okwetaba kwange mu kunoonyeleza kunno kwakyeyagalile era sikakidwa. Teri bubenje bwona bwenyinja kufuuna mu kunonyeleza kunno era nsoboola akuuva mu kunonyeleza kunno obudde bwonna bwemba njagalidde era nga kiinno tekijja kossa nzijanjabwa yange mu dwaliro linno.

Nzikiliza okwetaba mu kunonyeleza kunno okukwata ku nkozesebwa ya ka tiivi mu Mulago National referral Hospital.

Omukono.....

Omujanjabi enamba y'essimu

Abaddewo

Anoonyeleza omukulu Dr Peter Mbidde Musiitwa

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APPENDIX III: QUESTIONNAIRE

Date of FAST.....
Serial No.....
Hospital identification number.....
Ward.....
Patients/ NOK phone number.....

Demographic data

1. Age in years.....
2. Sex
 - 1) Male []
 - 2) Female []
3. Tribe.....
4. Nationality.....
5. District of origin.....
6. Date of injury.....
7. Time of injury.....
8. Date of admission.....
9. Time of admission.....
10. Ward.....
11. IP No.

Clinical Data

History

12. Circumstances of the Injury

- 1) Road traffic crash []
- 2) Assault []
- 3) Fall []
- 4) Others (specify).....

13. If RTC

- 1) Motorbike []
- 2) Bus/Taxi []
- 3) Private car []
- 4) Others (Specify).....

14. If motorbike
- 1) Passenger []
 - 2) Rider []
 - 3) Pedestrian []
15. Time of injury.....Duration.....
16. Pulse rate.....
17. Blood pressure.....
18. External injuries
- 1) Nil []
 - 2) Bruises []
 - 3) Abrasions []
 - 4) Lacerations []
 - 5) Cuts []
 - 6) Burn []
19. Location of external injuries
- 1) Abdomen []
 - 2) Chest []
 - 3) Other []
20. Glasgow coma score
- 1) Eye opening []
 - 2) Verbal response []
 - 3) Best motor response []

Abdominal Examination

21. Abdominal distension
- Yes []
 - No []
22. Movement with respiration
- 1) Yes []
 - 2) No []
23. Guarding
- 1) Yes []
 - 2) No []

24. Tenderness

1) Yes []

2) No []

25. Shifting dullness

1) Yes []

2) No []

26. Bowel sounds

1) Present []

2) Absent []

FAST findings

27. Presence of intraperitoneal fluid

1) Yes []

2) No []

28. Presence of hemo-pericardium

1) Yes []

2) No []

29. SSORTT Score

1) FAST findings []

2). Systolic blood pressure []

3). Pulse rate []

Total []

Abdominal ultrasound Scan findings

30. Presence of intraperitoneal fluid

1) Yes []

2) No []

31. Presence of organ injury

1) Yes []

2) No []

Management

32. Types of management

1) Operative []

2) Non operative []

33. Surgical management findings

- 1) Hemoperitoneum []
- 2) Solid organ injury []
- 3) Gut perforation []
- 4) Mesenteric tears []
- 5) Others []

34. Therapeutic Laparotomy

- 1).Yes []
- 2).No []

35. Outcomes of non operative management

- 1) Successful []
- 2) Failed []

36. Failed findings at operation.....

- 1) Therapeutic []
- 2) Non therapeutic []

37. Patient's disposition at three days

- 1) Died []
- 2) Discharged []
- 3) Still at hospital []

38. Post mortem findings

39. Date of discharge.....

40. Date of Death.....

41. Patient disposition at one week

- 1) Died
- 2) Discharged
- 3) Still at hospital

42. Postmortem findings if patient died

43. Date of discharge.....

44. Date of Death.....

45. Time of FAST.....

APPENDIX IV: BUDGET

ITEM	Unit cost (UGX)	Quantity	Total cost (UGX)
CAPITAL EXPENSES	300,000		300,000
Printer and toner	200 000	1	200 000
External hard disc	300 000	1	300 000
RECURRENT EXPENSES			500 000
Stationary			500 000
Binding books			200 000
Communication			200 000
Internet			200 000
Other research sources			300 000
Transport			200 000
Statistician	300 000	1	500 000
Research assistants	200 000		400 000
Contingency funds			500 000
TOTAL			4,300, 000

APPENDIX V: WORK AND TIME PLAN OF THE STUDY

YEAR	2012												2013				
Activity	January	February	March	April	May	June	July	August	September	October	November	December	January	February	March	April	May
Proposal development																	
Presentation (dept)																	
Presentation (IRB)																	
Data collection																	
Data analysis																	
Thesis writing																	
Thesis defense																	

APPENDIX VI: SSORTT Scoring System

Variable	Points
Ultrasound Score	
0 (no free fluid)	0
1 (fluid in one location)	2
>1 (fluid in more than one location or >2mm in Morison's or Douglas' pouch)	3
Pulse rate	
<120 beats/minute	0
≥120 beats/minute	2
Systolic Blood Pressure	
≥90 mm Hg	0
<90 mm Hg	1
TOTAL =	0-6