UGANDA MARTYRS UNIVERSITY

MOTHER KEVIN POSTGRADUATE MEDICAL SCHOOL

SHORT TERM POOR OUTCOME DETERMINANTS OF PATIENTS WITH TRAUMATIC PELVIC FRACTURES: A CROSSECTIONAL STUDY AT THREE PRIVATE NOT FOR PROFIT HOSPITALS OF NSAMBYA, LUBAGA AND MENGO.

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A DISSERTATION TO BE SUBMITTED IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF THE DEGREE OF MASTER OF MEDICINE IN SURGERY OF UGANDA MARTYRS UNIVERSITY

DEDICATION

I dedicate this work to my dear wife, children and siblings for their faith in me, their unwavering love and support and to my teachers for their availability, patience, guidance, shared knowledge and moral support.

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ABBREVIATIONS

ASIS	**:**	Anterior Superior Iliac Spine
BP	**:**	Blood Pressure
FAST	**:**	Focused Assessment with Sonography for Trauma
GCS	**:**	Glasgow Coma Scale
GUI	**:**	Genito-urinary Injury
ICU	**:**	Intensive Care Unit
IRB	**:**	Institutional Review Board
ISS	**:**	Injury Severity Score
LOS	**:**	Length Of Stay
MKPGMS	**:**	Mother Kevin Post Graduate Medical School
MOF	**:**	Multiple Organ Failure
NYU	**:**	New York University
OR	**:**	Operating Room
ORIF	**:**	Open Reduction and Internal Fixation
PNFP	**:**	Private Not For Profit
PSIS	**:**	Posterior Superior Iliac Spine
RTC	**:**	Road Traffic Crash
RTS	**:**	Revised Trauma Score

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ABSTRACT

Background: Although relatively rare, pelvic fractures signify major trauma that are frequently associated with multiple injuries, threat to life and poor functional outcome. This study aimed to establish poor outcome determinants in traumatic pelvic fracture patients admitted and treated at three urban PNFP Hospitals in Kampala.

Methods: A cross-sectional study reviewing charts of patients admitted and treated at three urban PNFP hospitals in Kampala, Uganda between January 2014 and December 2018. A pretested data abstraction form was used to obtain data. All variables with a p-value < 0.24 at bivariate logistic regression were included in multivariate analysis. A backward stepwise elimination method was used to identify predictors of poor outcome, with Odds Ratios at 95% confidence intervals used to report results. Data was analyzed using STATA version 14.0 at a p-value < 0.05.

Results: Of the 73 patients admitted and treated for pelvic fractures, 40(54%) were males and the mean age of 37.4± 17.7 years. Overall, 83.3% fractures were stable while 16.7% were unstable. The most commonly associated injuries were in extremities (52.38%), head and neck region (25.40%), abdomen (7.94%) and chest regions (7.94%). Factors significantly associated with poor outcome among patients with pelvic fractures were surgical intervention (p = 0.001) and poor heart rate (p = 0.008), regardless of whether stable or unstable pelvic fractures.

Conclusion: Poor Outcome determinants for pelvic fracture were operational interventions and elevated heart rate. Associated injuries were mainly in the extremities and head and neck regions. Deliberate and focused attention should be given to stabilize the cardiovascular system in pelvic fracture patients who present with elevated heart rate.

Very close monitoring of pelvic fracture patients who require or have undergone operative intervention is very essential for optimal outcome.

Key words: Outcome determinants, Poor outcomes, Pelvic Fractures, Urban Hospitals in Kampala, St. Francis Hospital Nsambya, Uganda Martyrs University Nkozi

OPERATIONAL DEFINITIONS

Fracture	:	A partial or complete discontinuity of bone *(Complete Medical Dictionary)*
Fracture displacement	:	Loss of alignment of ends of fractured bone *(Web MD)*
Short Term	:	Six weeks
Poor Outcome	:	Hospitalization for 8 days or longer, ICU admissions, death
Significant associated injuries	:	Injury other than the pelvic fracture, involving extensive tissue loss, organ damage or musculoskeletal breach /disruption.

Chapter 1
INTRODUCTION AND BCAKGROUND

1.0 Introduction

Pelvic fracture is a breach in the continuity of the pelvic bone. It is a result of devastating injuries and is usually encountered in conjunction with other life threatening injuries (Paydar et al., 2017)

According to the Bulletin of the NYU Hospital for Joint Diseases 2010, the inherent stability of the pelvic ring afforded by its osseous and ligamentous anatomy typically requires high energy traumatic events to cause fracture. Various clinical and biomechanical studies have demonstrated that the force vector applied to the pelvis dictates the resultant fracture pattern.

The severity of pelvic fractures, range from simple and mostly harmless type A, to the life-threatening complex Type C fractures (Tile's Classification) (Holstein et al., 2016)

To be useful, any predictive system or classification must use only information that is available early in the patient's course of management. Age, fracture pattern, systolic blood pressure on arrival, base deficit, and the Revised Trauma Score (RTS) all give of information that are valuable to the clinician at the time the patient presents.

1.1. Background of the Study

Trauma remains a tremendous cause of morbidity and mortality in most countries. The objective of our study was to identify poor outcome determinants in pelvic fracture at three urban PNFP Hospitals in Kampala over a five year period retrospectively.

More often, pelvic fracture victims suffer multiple injuries and their management therefore requires a multi-disciplinary approach. The acute management of a patient with pelvic fracture and unrelenting haemorrhage presents a major challenge to Orthopaedic Surgeons. One of the main injuries in high energy trauma is pelvic fracture, which accounts for about 10% to 40% of these cases. Delayed recognition and inappropriate management of the trauma patient with pelvic injury can lead to a poor and fatal outcome.

According to Biomedical Research in Uzbekistan, mortality of pelvic fracture patients in association with multiple injuries ranged from 30% to 58%. Pelvic fractures represented the third most common cause of death in trauma. Pelvic ring fractures typically follow high energy trauma from motor vehicle accidents, falls from significant heights or ground levels in geriatric patients and crush injuries. These are common occurrences in developing countries, which have limited, inadequately functional healthcare facilities. Traumatic injury to the pelvis invariably results in single or multiple fractures with consequent immobility. Low-energy pelvic fractures occur in two distinct age-groups:

1. **Adolescents**, who typically present with avulsion fracture of superior and/ or inferior iliac spine, or apophyseal avulsion fractures of the iliac wing or ischial tuberosity resulting from athletic/ sports injury.

2. The **elderly**, often from a fall while ambulating, highlighted by stable fractures of the pelvic ring. They may also present with insufficiency fractures, typically of the sacrum and anterior pelvic ring.

High-energy pelvic fractures often occur during motor vehicle crushes, motor cycle crushes motor vehicle or motor cycle striking a pedestrian or falls from heights (Lee et al., 2017).

The fundamental objective of emergency management of pelvic ring injury is control of haemorrhage restoration of haemodynamic state and prompt evaluation and treatment of associated injuries. The clinical process of achieving these objectives has evolved significantly (Lee et al., 2017).

St. Francis Nsambya, Uganda Martyrs Lubaga and Mengo Hospitals, by virtue of their location and levels of expertise cater for the urban and peri-urban population that is exposed to:

1- High volume of motor vehicles and high incidence of RTC; road traffic collisions are the greatest cause of morbidity and mortality from injury in Kampala, Uganda *(Demyttenaere et al., 2009)*.

2- Gun crime, which among other injuries, contributes to pelvic fractures.

3- Numerous construction activities, with associated accidents of human falls and heavy objects falling on construction workers, also contributing to pelvic fractures. The three factors noted above have been established from a pilot study conducted at Nsambya Hospital between 2016 and 2017 (Records).

It is therefore important that studies such as this one (Out-come Determinants of Pelvic Fracture) and many more be conducted, in order to inform the basis of intervention in the care of Pelvic fracture patients, in order to improve care and outcome.

1.2. Statement of the Problem

Records at St. Francis Hospital Nsambya revealed an ever increasing number of pelvic fracture patients, therefore there was a need to have a more informed approach to care in order to minimise poor outcome in these individuals.

From the same records, it was noted that many pelvic fracture patients had prolonged hospital stay, ranging from three to over six weeks, while others died in hospital days later.

The three PNFP Hospitals are fast growing tertiary hospitals, which make significant contribution to health care provision; this therefore spells the need for ongoing research, to improve patient care and outcome.

1.3. Objectives of the Study

1.3.1 General Objective

The main aim of the study is to establish poor outcome determinants in traumatic pelvic fracture patients admitted and treated at St. Francis Nsambya, Uganda Martyrs Lubaga and Mengo Hospitals between and including January 2014 and December 2018.

1.3.2 Specific Objectives

1- To determine the patterns of pelvic fractures among trauma patients admitted at St. Francis Hospital Nsambya, Uganda Martyrs Hospital Lubaga and Mengo Hospital.

2- To determine the associated injuries among these pelvic fracture patients admitted at St. Francis Hospital Nsambya, Uganda Martyrs Hospital Lubaga and Mengo Hospital.
3- To identify determinants of poor outcome among patients with traumatic pelvic fractures among trauma patients admitted at St. Francis Hospital Nsambya, Uganda Martyrs Hospital Lubaga and Mengo Hospital

1.4. Research Question

What are the determinants of poor outcomes in patients with pelvic fractures as seen at St. Francis Hospital Nsambya, Uganda Martyrs Hospital Lubaga and Mengo Hospital?

1.5. Scope of the Study

1.5.1 Content Scope

This study aims at establishing determinants of poor outcome in traumatic pelvic injury patients as seen in St. Francis Hospital Nsambya, Uganda Martyrs Hospital Lubaga and Mengo Hospital.

1.5.2 Geographical Scope

The study settings were St. Francis Nsambya, Uganda Martyrs Lubaga and Mengo Hospitals in Kampala.

St. Francis Hospital Nsambya, which is one of the .private, tertiary level referral and teaching hospitals in Uganda with a bed capacity 361, founded by the Little Sisters of Asisi in 1903, owned by the Roman Catholic Archdiocese of Kampala and managed by the Little Sisters of Asisi. St. Francis Hospital Nsambya is located in Kampala the capital city of Uganda, in Makindye Division. It receives a wide variety of trauma patients and under 5% being pelvic fracture patients.

The hospital has a catchment population of 89,516 but an additional number of people from the surrounding zones and nearby regions visit the hospital both for in and out-patient care.

Uganda Martyrs Hospital Lubaga is a 275 bed tertiary Hospital founded in 1899 by the Missionary Sisters of Our Lady of Africa, run by the Roman Catholic Archdiocese of Kampala.

It is located on Lubaga Hill in Lubaga Division, in the western part of Kampala. The Hospital lies about 5.5Km south-west of Mulago National Referral Hospital. (WikiMili; update 27th June 2019). An estimated under 2% of their trauma patients pelvic fracture patients.

Mengo Hospital also known as Namirembe Hospital, is a tertiary health facility, founded in 1897 (the oldest Hospital in Uganda), by Sir. Albert Ruskin Cook on Namirembe Hill, along Albert Cook road in Lubaga Division - Kampala District.

An estimated under 0.5% of their trauma patients are pelvic fracture patients.

All the three hospitals are PNFP hospitals and the study settings were their Records Departments.

1.5.3 Time Scope

The time scope for this study is from January 2014 to December 2018 inclusive.

1.6. Significance of the Study

1- This study will hopefully become part of the reference documents for strategic planning and clinical decision making in the management of pelvic fracture patients at St. Francis Hospital Nsambya, Uganda Martyrs Hospital Lubaga, Mengo Hospital and elsewhere.

2- It will be a reference document for similar/related future studies.

3- It will help identify gaps in the study area to be explored.

1.7. Justification of the Study

A poor outcome observed in medical records at St. Francis Hospital Nsambya in 2017 was the primary motivation to conduct this study.

Up to 33% less files were reviewed at St. Francis Nsambya Hospital due to pitfalls in record handling, which necessitated a multi-site study.

Pelvic fractures, although relatively rare, often signify major trauma, and are frequently associated with multiple injuries and continue to present a challenge in terms of life-threat and poor functional outcome.

Despite advances in management during the past decade, mortality remains significantly high, with mortality rates ranging between 10% and 16% (Paydar et al., 2017). They are also associated with significant morbidity and disability. It is therefore important to minimize poor outcomes by identifying priority determinants right from the onset of care and intervening appropriately.

Although management of pelvic fracture patients has evolved over decades from non-operative to both operative and non-operative, and studies have been conducted on pelvic fractures, there is still knowledge gap in the management of pelvic fractures.

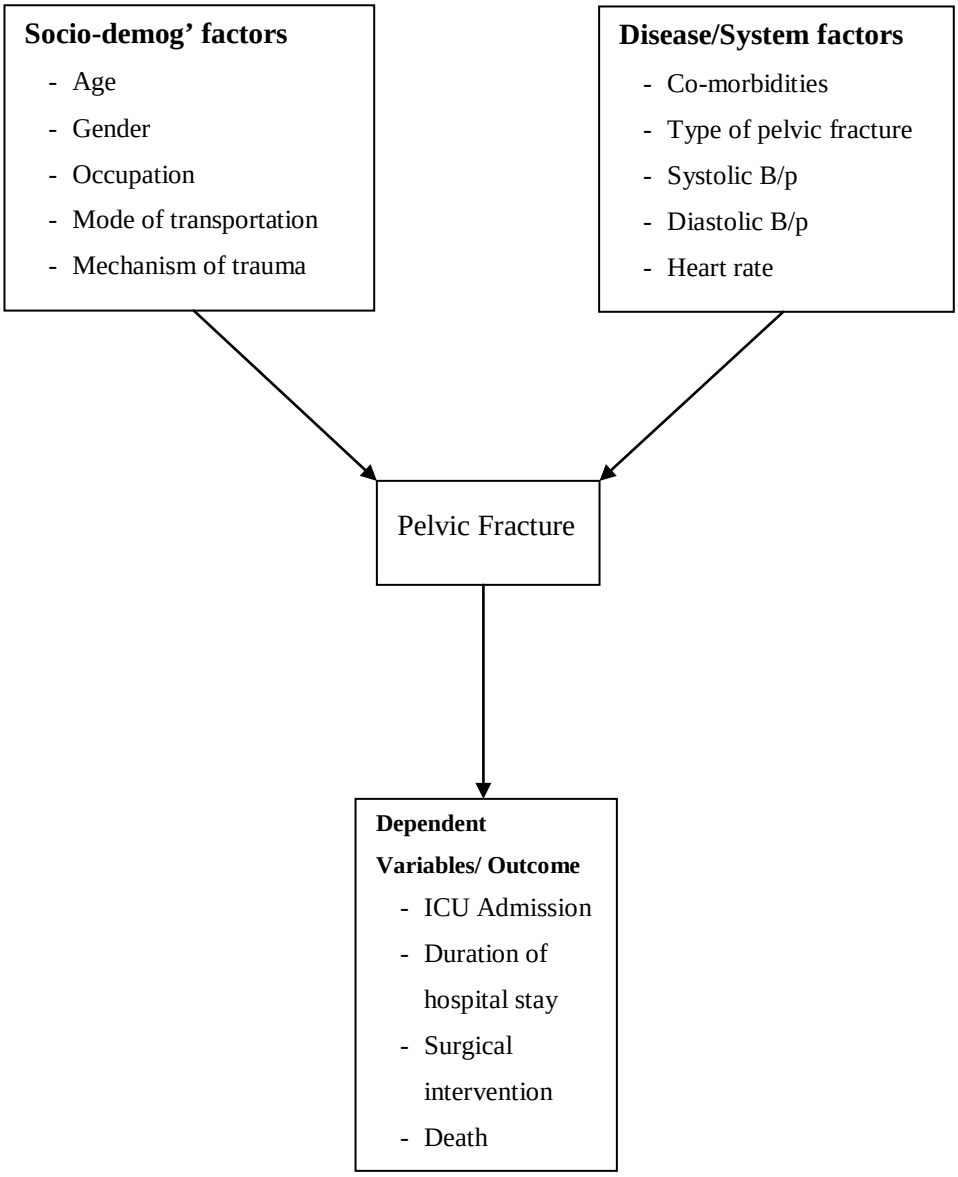
According to the Department of Public Health, Faculty of Medicine, Heinrich-Heine University, Düsseldorf, Germany, in comparison to hip fractures, which have been thoroughly studied, pelvic fractures have as yet only been analyzed to some extent. This further emphasises the knowledge gap existing, hence the need for continued research.

Although pelvic fractures are rare injuries relative to fractures in other body regions (3% - 8%), they are accompanied by high mortality (5% - 20%), and the survivors suffer severe chronic pain and pelvic related handicap. However, death attributed directly to pelvic injuries accounted for 11% (Hauschild et al., 2008).

According to McCormack et al. (2010)**,** the incidence of pelvic fracture appears to be increasing, secondary to increases in the number of high-speed motor vehicle accidents and the number of patients surviving these accidents, due to airbags and safer car designs. Among multiply injured patients with blunt trauma, almost 20% have pelvic injuries.

No formal study has ever been conducted in St. Francis Hospital Nsambya, Uganda Martyrs Lubaga and Mengo Hospitals, on outcome determinants of traumatic pelvic fractures; there was therefore need to carry out this study, to inform practice and avail statistics for related studies in the future.

1.8. Conceptual Framework



Chapter 2
LITERATURE REVIEW

2.0 Introduction

Relevant Anatomy and Biomechanics

Pelvic Ring

The bony pelvis is made of ilium, ischium and the pubis, which fuse together as a unit known as the pelvic girdle, attached to both sides of the spine to form an anatomic ring with the sacrum and sockets for the hip bones. It plays a significant role in the stability and transmission of weight from and through the trunk and the legs. It also cradles many internal organs and neurovascular trunk, muscles and ligaments that further stabilize it (Dimon, 2008).

Additional posterior support is provided by the anterior and posterior sacroiliac ligaments, along with the ilio-lumbar ligaments, which connect the transverse processes of the L5 vertebral body to the iliac crest. Altogether, these posterior structures function as a tension band resisting rotational and vertical displacement forces.

Mechanisms of Injury

The inherent stability of the pelvic ring afforded by its osseous and ligamentous anatomy typically requires high energy traumatic events to cause fracture. Various clinical and biomechanical studies have demonstrated that the force vector applied to the pelvis dictates the resultant fracture pattern

Fractures of the pelvic ring are comparatively rare with incidence of 2% - 8% **of all fractures**. The severity of pelvic fractures, range from simple and mostly harmless type A, to the life-threatening complex type C fractures *(Holstein et al., 2016).*

Low-energy pelvic fractures occur in two distinct age-groups:

High-energy pelvic fractures often occur during motor vehicle crushes, motor cycle crushes motor vehicle or motor cycle striking a pedestrian or falls from heights (Gettys et al., 2011).

According to Andre Samuel, BBA et al, in their study published in the Orthopaedic and Trauma Association (OTA) journal in 2015, established an average hospital stay of 7 days, which we adopted in our study.

Classification

The spectrum of pelvic fractures ranges from pubic ramus fractures, which are low energy fractures to high energy unstable fractures, which can result in massive blood loss and associated morbidity and mortality.

Fracture classification systems must identify and describe the fracture pattern, must aid in treatment protocol, and help in predicting the treatment outcome. There are classifications of pelvic fracture which adequately define the injury pattern and assist in management planning, but are associated with inter- and intra-observer variations.

The various classification systems which are commonly used in pelvic fracture are:

1. Anatomical classification by Letournel.
2. Classification based on stability and deformity.
3. Orthopedic Trauma Association classification — mainly useful for research.
4. Classification based on vector force and associated injuries by Young and Burgess.

1- Anatomical Classification by Letournel

Letournel defined the fracture pattern on the basis of the area of pelvic bone involved. He divided all fractures in two groups — anterior and posterior.

Anterior fractures include

• Ramus fractures
• Symphyseal disruption

Posterior fractures include

• Iliac wing fracture
• Iliac wing/SI joint fracture (crescent fracture)
• SI joint fracture

• Sacrum/SI joint fracture
• Sacrum fracture

2- Classification based on stability and deformity by Pennel, Bucholz, and Tile (Haq et al., 2014)

With the introduction of external fixators, there was marked improvement in managing pelvic Fractures. The concept of "force vector" causing the fracture and "counter force" required to reduce the fracture was understood. This concept was introduced by Pennel in 1961 and was further modified by **Bucholz** and **Tiles**, who added the concept of stability in the classification.

Pennal *et al* described the fracture pattern on the basis of mechanism of injury:

- Anteroposterior compression (APC) injury
- Lateral compression (LC) injury
- Vertical shear (VS) injury pattern

According to Tiles classification fracture pattern was classified as follows:

- **Type A**: Stable fracture. These are the fractures with intact soft tissues around the pelvis, not disrupting the ligaments.
  A-1 — Fracture of innominate bone; avulsion
  A-2 — Fracture of innominate bone; direct blow
  A-3 — Transverse fracture of sacrum and coccyx
- **Type B**: Rotationally unstable, but vertically stable.
  B-1 — Unilateral partial disruption of posterior arch, external rotation ("open book" injury)
  B-2 — Unilateral, partial disruption of posterior arch, internal rotation (LC injury)
  B-3 — Bilateral, partial lesion of posterior arch
- **Type C**: Rotationally and vertically unstable.
  C-1 — Unilateral, complete disruption of posterior arch
  C-2 — Bilateral, ipsilateral complete, contralateral incomplete
  C-3 — Bilateral, complete disruption.

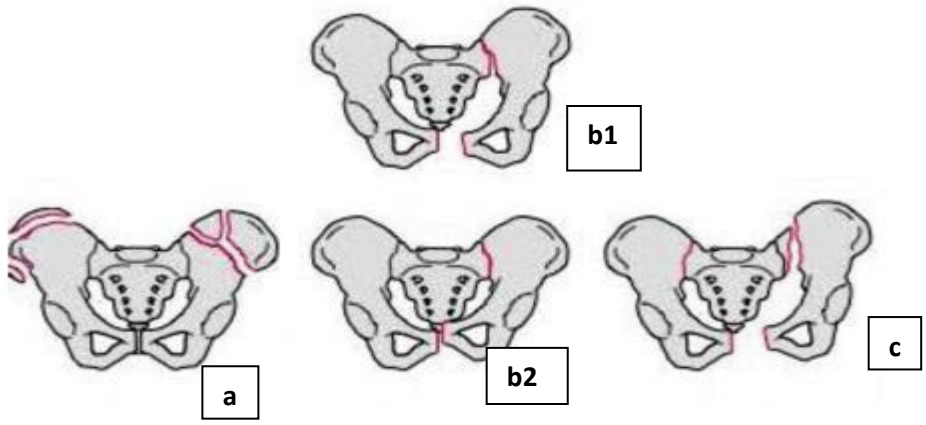


Figure 1: (a) Stable fractures. (b1 and b2) Rotationally unstable and vertically stable. (c) Rotationally and vertically unstable

Associated Injuries

Secondary to the high-energy mechanisms of injury required to cause a pelvic fracture, these injuries are commonly associated with injuries to other body systems. Epidemiologic studies have reported that 12% to 62% of patients with pelvic fractures had additional injuries to the thorax, brain, long bones, and abdominal organs, to include the genitourinary system, spine, and the peripheral nervous system. In Gänsslen's multicenter review, of the 312 pelvic fracture patients with associated injuries, 63% had injury to the bladder or urethra, 35% had associated head injuries, 24% had nerve injuries, and 20% had intestinal injuries. Basta and associates found the location and displacement of anterior pelvic fractures were predictive of the presence of urethral injury in a case control study of pelvic fracture patients with and without associated urethral injury. They observed that each millimeter of pubic diastasis or inferomedial pubic bone fracture fragment displacement was associated with a 10% increased risk of urethral injury (McCormack et al., 2010).

ATLS Assessment and Management

Initial hospital evaluation and management in the emergency room proceeds according to the guidelines of the Advanced Trauma Life Support (ATLS) protocol.

The primary survey includes an assessment of the patient's airway and breathing, while intravenous access is obtained with two large bore IVs, allowing for resuscitation to occur

simultaneously with the diagnostic evaluation. Hemodynamic stabilization is of paramount importance in the initial management phases of suspected pelvic fractures. Once the airway has been adequately secured, a search for potential sources of bleeding is started. Inspection during the primary survey may identify signs of injury-associated hemorrhage, such as flank ecchymosis or scrotal edema. Trauma radiographs, including anteroposterior views of the chest and pelvis, may also help localize a bleeding source. The Focused Assessment with Sonogram for Trauma (FAST) may be utilized in the emergency setting to identify intraperitoneal fluid. In many centers, a positive FAST exam in a hemodynamically unstable patient is an indication for immediate abdominal exploration. In a recent retrospective review of the utility of FAST exams in pelvic fracture patients, Tayal and associates reported an overall sensitivity of 81% and a specificity of 87%. In cases where the FAST is equivocal and ongoing hemorrhage is suspected, a diagnostic peritoneal lavage (DPL) is a useful additional assessment tool. Using a supra-umbilical insertion site, a DPL yielding more than 8 cc of blood is considered positive for intraperitoneal bleeding, prompting emergent abdominal exploration. The supra-umbilical site is preferred in pelvic fracture patients to avoid the possibility of false positive results occurring, secondary to aspiration of the pelvic fracture hematoma.

Physical Examination of the Pelvis

Once active hemorrhage and life-threatening associated injuries have been ruled out during the primary survey, the physical examination can then be focused on the pelvis.

Recent studies have demonstrated that clinical examination can be sensitive in the identification of pelvic fracture in the conscious and interactive patient. Gonzalez and colleagues, in their review of 2176 blunt trauma patients, reported that, a focused physical examination had 93% sensitivity for the diagnosis of pelvic fracture.

Significant shortening or external rotation of one of the patient’s lower extremities on inspection may help identify VS (vertical shear) or an open-book antero-posterior compression (APC) type pelvic injury. Palpation of the anterior pelvis may demonstrate a symphyseal gap indicative of diastasis. Compression testing in the antero-posterior direction through applied downward pressure on the anterior superior iliac spines (ASISs) and in the lateral direction via compression of the iliac crests is performed in an effort to identify pelvic rotational instability.

Pelvic compression should be limited to a single attempt, in an effort to limit repeated disruption of fracture site clots.

Rectal and pelvic examinations are of utmost importance during the initial evaluation to rule out the presence of an open fracture. Blood in the vaginal vault or in the rectum should raise the level of suspicion for an open injury. Palpable bony spicules within the rectum or vagina may be present indicating an open injury. A high-riding prostate may also be detected on rectal examination, indicating the presence of a periurethral or periprostatic hematoma occurring secondary to genitourinary injury.

When possible, a complete neurologic examination should be performed, focusing on sciatic nerve and sacral plexus function, as these nerves are at risk for injury. Evaluation of rectal tone and the presence of the bulbocavernosus reflex are included in the initial neurologic evaluation.

Diagnosis of Associated Injuries

Genitourinary

Large case series have reported that genitourinary injury occurs in as many as 15% to 20% of pelvic fracture cases. Identification of blood at the urethral meatus, gross hematuria, or significant penile or scrotal swelling or ecchymosis should raise suspicion for injury to the bladder or urethra and warrant a urology consult and further work-up, including a urethrogram or possible operative exploration. Additionally, the pelvic fracture pattern, as seen on the initial antero-posterior trauma pelvic radiograph, may predict the risk of genitourinary injury. Basta and coworkers, in a case-control review of 119 pelvic fracture patients, correlated anterior pelvic fractures (in particular, inferomedial pubic bone fracture or pubic symphysis diastases with 1 cm or more of displacement) with associated urethral injury. The investigators found that each millimeter of pubic symphysis diastasis or inferomedial pubic bone fracture displacement was associated with a 10% increased risk of urethral injury.

Andrich and associates reviewed 108 males and females with pelvic ring fractures at their institution and found that 27 (25%) had lower urinary tract injuries (LUTI). Although the study failed to show a correlation between pelvic fracture mechanism (Tile A, B, or C) and the presence of a LUTI, the study did find that more severe urethral injuries (complete urethral disruption and complex LUTI) occurred only in males with Tile C injuries. In a retrospective

review of 721 patients with blunt trauma pelvic fractures, Avey and colleagues found 37 bladder ruptures (5%), all of which had hematuria greater than 30 RBC/HPF (red blood cells per high-power field). Pelvic injuries associated with bladder injury included diastasis of the pubic symphysis greater than 1 cm and fracture of the obturator ring, with a displacement greater than 1 cm.

The 2018 European Association of Urology (EAU) guidelines include the following recommendations:

- Evaluation of urethral injuries with flexible cystoscopy and/or retrograde urethrography.
- Treat blunt anterior urethral injuries by suprapubic diversion.
- Partial posterior urethral ruptures should be treated by urethral or suprapubic catheterization.
- Perform early endoscopic re-alignment when feasible.
- Manage complete posterior urethral disruption with complete suprapubic diversion.

Gastrointestinal

Intra-abdominal injuries can occur with pelvic fractures. Bowel can become entrapped within a pelvic fracture and present as an acute intestinal obstruction or intermittent ileus. Stubbart and Merkley reported a case of descending and sigmoid colon herniation resulting from an ilium fracture (Stubbart and Merkley, 1999). Although a review of the literature shows that bowel entrapment is a relatively rare complication, it can be fatal and must be differentiated from adynamic ileus, a more benign condition that occurs in up to 5% to 18% of pelvic fractures, which lasts an average of 3 days. Patients with pelvic fractures and a persistent ileus should undergo a CT with enteric contrast to rule out occult bowel injury, such as entrapment at the pelvic fracture site.

Hemorrhage

All pelvic fractures are associated with some form of bleeding. Sources of blood loss include cancellous bone at the fracture site, laceration of retroperitoneal veins in the pelvis, and laceration of branches of the internal iliac artery, which accounts for approximately 25% of hemodynamically unstable pelvic fractures. It is difficult to determine whether a patient is

hemorrhaging from a venous or an arterial bleed. Arteriography can identify arterial bleeding, venography shows venous bleeding (although it is difficult to distinguish between major or minor bleeds), and pelvic CT can show the presence of a hematoma. Huittinen and Slätis performed a cadaveric study of 27 patients with pelvic fractures who died from hemorrhage. Postmortem anatomic dissection and arteriography of the hypogastric artery was performed (Huittinen and Slätis, 1973).

Extravasation from the hypogastric artery through the cancellous bone and torn tissues was seen in 23 cadavers. Based upon their findings, Huittinen and Slätis concluded that "accurate reposition of the dislocated pelvic fracture is preferable to ligation of the hypogastric arteries for control of severe hemorrhage from pelvic fractures."

Early identification of patients with hemorrhage is critical in management. Although evaluation of patients with blunt abdominal injury, typically, involves a focused assessment with sonography for trauma (FAST) exam, in patients with pelvic fractures, a negative exam does not rule out intraperitoneal haemorrhage.

Emergency Methods of Provisional Pelvic Stabilization

In the emergent setting, the orthopedic surgeon has a number of options for provisional pelvic stabilization to help tamponade bleeding in patients with pelvic fractures who are hemodynamically unstable, including using a pneumatic anti-shock garment (PASG), wrapping a sheet around the pelvis, or placing a pelvic binder on arrival, as well as more definitive fixation with an anti-shock pelvic clamp (C-clamp) or traditional anterior external fixation.

Pneumatic Anti-Shock Garment (PASG).

PASG, also known as a military anti-shock trouser, is sometimes used in the pre-hospital and emergency room setting to increase blood pressure, reduce pelvic fractures, and tamponade hemorrhage. A number of problems have occurred with the PASG, however, including lower extremity ischemia and compartment syndrome. The PASG is bulky, and when in place, it is difficult to access the abdomen, genitourinary system, and lower extremities. While there may be theoretical benefits to the PASG, Chang and colleagues48 showed in a prospective

randomized study of 248 patients with traumatic shock that PASG provided no mortality benefit or difference in hospital stay as compared to no PASG.

Wrapping Sheet

Circumferential compression with a sheet around the pelvis or a pelvic binder can be used as an emergent method of stabilizing the pelvis and reducing pelvic volume in open-book pelvis fractures. The sheet should be placed at the level of the greater trochanter and wrapped tightly around the patient and secured with a clamp or cable ties. A bolster should be placed under the knees and the lower thighs, and ankles should be bandaged together to help stabilize the pelvis. Nunn and coworkers presented a series of seven haemodynamically unstable patients with pelvic fractures (APC II, APC III, LC (Lateral Compression) III, and CMI), showing that circumferential compression with a sheet helped stabilize the patient by increasing blood pressure and reducing tachycardia; patients still required significant fluid resuscitation and blood transfusions over the subsequent 12 hours (McCormack et al., 2010).

Pelvic Clamping

Ganz and associates introduced the C-clamp as a tool to rapidly stabilize posterior pelvic ring fractures in hypotensive patients. Using their instructions to place the C-clamp, the PSIS is first palpated. The entry point of the Steinmann pins is noted to be three to four fingerbreadths anterolateral to the PSIS, along a line drawn between the ASIS and the PSIS. A stab incision is made over the entry point, the pins are advanced to bone and driven in 1 cm with a hammer.

The hemi-pelvis is compressed with the side arms using a wrench. In a retrospective review of 14 patients in hemorrhagic shock with unstable B or C pelvic ring fractures and who were treated with a pelvic C-clamp, Sadri and colleagues found that five patients remained haemodynamically unstable and required arterial angioembolisation. Although exact times were not reported, they stated patients who required pelvic C-clamps were taken to the operating room within 2 hours of arrival to the hospital, and a C-clamp was placed within 20 minutes; thus, extrapolating these results to practice requires an efficient triage set-up and readily available orthopaedic and support staff.

External fixation via anterior stabilization can be performed for partially stable (type B) pelvic fractures. There are two sites for anterior pin placement, either in the superior iliac crest above the ASIS or lower between the iliac spines (which allows easier access to the abdomen). The pullout strength at these two sites is comparable. Pins can be placed percutaneously or through an open technique. Two or three pelvic pins are placed in each crest and connected via a rectangular or trapezoidal frame. Reduction of the pelvic fracture occurs by correction of the displacement (typically, with internal rotation for open-book fractures or external rotation for LC fractures). Unstable pelvic fractures (type C) can be mechanically fixed with either a pelvic C-clamp or traditional external fixation and distal femur skeletal traction.

Bassam and coworkers prospectively evaluated external fixation, as compared to angiography, in 15 patients with pelvic fractures who were hemodynamically unstable. Based upon a previous study, which showed that posterior arterial bleeding from the internal iliac artery or its posterior branches was more common in unstable posterior pelvic fractures, this group divided these patients into either anterior pelvic ring fractures (APC I and LC I) or posterior pelvic ring fractures (APC II, APC II, LC II and LC III). Patients with anterior fractures were treated initially with emergent external fixation, whereas patients with posterior fractures were treated initially with arterial angiography and embolisation. Of note, patients with anterior and posterior pelvic ring fractures were treated with an external fixator if the fracture was vertically stable and with angiography if the fracture was vertically unstable. Eight patients were treated initially with external fixation, whereas seven patients underwent angiography. Four of the eight patients who were treated with external fixation required angiography for continued hemodynamic instability, whereas none of the patients who were treated initially with angiography required external fixation. Three patients in the external fixator group suffered large buttock and thigh hematomas (as compared to no hematoma complications in the angiography group).

From these results, Bassam and associates concluded that all patients with pelvic fractures who were haemodynamically unstable should be treated with arterial angioembolisation, regardless of fracture type.

Mortality

Mortality rates associated with pelvic fractures range from as low as 5% to 10% to as high as 50% to 60% in the orthopaedic surgery and trauma literature. This variability in reported mortality rates is likely related to significant differences in patient cohorts and fracture types reported in these studies. Hemodynamic instability and multiple organ failure (MOF) as direct consequences of pelvic hemorrhage have been identified as the primary causes of death following pelvic fracture. Smith and colleagues reported an overall mortality rate of 21% in their review of 187 hemodynamically unstable patients with pelvic fractures (Smith et al., 2007). Among patients who did not survive their injuries, autopsy findings demonstrated that the principal cause of death in 74% was exsanguination, while MOF was the primary cause in 18%.

The investigators found that, while fracture pattern and treatment with angiography-embolisation did not correlate with mortality, Injury Severity Score (ISS), Revised Trauma Score (RTS), age (greater than 60 years), and transfusion requirement (more than 6 units in the first 24 hours) were directly correlated. Demetriades and coworkers16 reported a 16.5% mortality rate among their 1545 pelvic fracture patients. In their study, an ISS greater than 25 was identified as the only risk factor associated with increased mortality. O'Sullivan and associates examined 174 consecutive patients with unstable pelvic fractures in an effort to identify specific risk factors for mortality. The investigators reported an overall mortality rate of 20% and found that an ISS of more than 25, an RTS score less than 8, an age greater than 65, systolic blood pressure under 100 mmHg, a Glasgow Coma Scale under 8, transfusion requirements of more than 10 units in the first 24 hours, and a colloid infusion of more than 6 liters in the first 24 hours were all associated with an increased risk of death from injury. The RTS was most predictive in this study, with a score less than 8 correlating with a 65% mortality rate.

Kido and colleagues22 performed a retrospective review of 102 consecutive patients with bleeding pelvic fractures and severe associated injury (ISS greater than or equal to 3) at their level I trauma center, to identify patient characteristics associated with increased early mortality (within 24 hours). At their institution, all patients with a pelvic fracture and signs of

intraperitoneal bleeding (hypotension) receive a computed tomography (CT) scan with IV contrast after initial fluid resuscitation to evaluate for bleeding. In the study, patients diagnosed with pelvic arterial bleeding (by extravasation of contrast) underwent transarterial embolisation.

Patients with intraperitoneal fluid collection on CT were taken to the operating room for exploratory laparotomy. Of the 102 patients, 47 died within 24 hours: 47% from hemorrhagic shock and 21% from central nervous system injuries. Head and neck injuries and shock symptoms (hypotension) were associated with increased risk of death, whereas the mechanism of injury and pelvic fracture type did not show an appreciable impact on mortality (McCormack et al., 2010).

According to S Paydar, MD et al, the risk of haemorrhage makes pelvic fractures the most serious skeletal injury resulting in substantial mortality that ranges from 5 to 50% in the literature and is dependent not only on the type of pelvic ring fracture but also on the severity of associated injuries involving the abdomen, chest, and central nervous system. Pelvic fractures continue to present a challenge in terms of life-threat and functional outcome. Despite advances in management during the past decade, mortality remains significantly high, with mortality rates ranging between 10% and 16% (Paydar et al., 2017).

From another study conducted in Uzbekistan, Akbar B Tilyakov et al report: there has been an increase in the incidence of pelvic ring fractures over the last decade because of rising number of high-speed accidents and trauma. Mortality rate of pelvic fractures in association with multiple injuries ranges from 30% to 58%. Pelvic fractures represent the third most common cause of death in trauma (Tilyakov et al., 2015).

Delayed recognition and inappropriate management of the trauma patient with pelvic injury can lead to a poor and fatal outcome. Multiple trauma associated with pelvic injury is also the leading causes of death and disability in Uzbekistan (Tilyakov et al., 2015).

Pelvic fractures have presented a great challenge to Orthopaedics Surgeons over the years. The approaches to their management have evolved over time from entirely non-operative to operative. Many classification systems have been fronted in an attempt to standardise care; however none has been exclusively adopted universally (Paydar et al., 2017).

The fundamental objective of emergency management of pelvic ring injury is control of haemorrhage, restoration of haemodynamic stability and prompt evaluation and treatment of associated injuries. The clinical process of achieving these objectives has evolved significantly. However regardless of the consensus that displaced pelvic ring injuries are the most serious Orthopaedics injuries requiring prompt surgical stabilization, controversy still exists regarding the recommended treatment and outcome.

More growing interests have been observed recently in the use of external fixation, as it involves minimally invasive, relatively easy and quick procedure to achieve pelvic stability, promoting fracture healing as well as to decrease the amount of haemorrhage and soft tissue injuries. This combined effect may decrease the mortality associated with major unstable pelvic fracture as well as decrease the incidence of associated complications, such as respiratory and/or renal failure and disseminated intravascular coagulopathy (Thamyongkit et al., 2018).

George V Russell Jr, in his article published in Medscape on 26th February 2018 stated, unstable and displaced pelvic ring disruptions cause significant deformity, pain, and disability. Deformities resulting from pelvic ring injuries include any combination of rotational and translational deformities. Significant permanent (sustained) pelvic deformities have been identified in poorer patient outcomes and decreased activity levels.

Pelvic fractures historically have been treated non-operatively. The earliest management of pelvic fractures consisted of prolonged recumbence followed by mobilization as fracture healing occurred and symptoms abated. Other methods also used to treat pelvic fractures included closed reduction under general anesthesia, *traction*, *spica casts*, *pelvic slings*, and *turnbuckles (George V Russell, 2018)*.

Another UK based study conducted at Queen Elizabeth Hospital had osteoporotic pelvic fracture patients over 60years old: It was found out that average length of hospital stay was associated with age, and significantly longer in those admitted with acute medical conditions.

Pelvic fracture patients between 55 and 87 years of age, with average ISS of 17.8 had an average hospital stay of 25 days. 30% of these patients required an average of 10 units of blood transfusion during their first 24 hour of admission (Dong et al., 2014).

Mortality rates associated with pelvic fractures range from as low as 5% to 10% to as high as 50% to 60% in the orthopaedic surgery and trauma literature. This variability in reported mortality rates is likely related to significant differences in patient cohorts and fracture types reported in these studies. Hemodynamic instability and multiple organ failure (MOF) as direct consequences of pelvic hemorrhage have been identified as the primary causes of death following pelvic fracture. Smith and colleagues19 reported an overall mortality rate of 21% in their review of 187 haemodynamically unstable patients with pelvic fractures. Among patients who did not survive their injuries, autopsy findings demonstrated that the principal cause of death in 74% was exsanguination, while MOF was the primary cause in 18% (McCormack et al., 2010).

Chapter 3
RESEARCH METHODOLOGY

3.1 Research Design

This was a cross-section study, with data retrieved from patients' medical records from January 2014 to December 2018.

3.2 Study Setting

The study settings were St. Francis Nsambya, Uganda Martyrs Lubaga and Mengo Hospitals' Records Departments.

3.3 Study Population

The study participants were patients managed at St. Francis Nsambya, Uganda Martyrs Lubaga and Mengo Hospitals, for pelvic fracture/s during the defined period (January 2014 to December 2018) who met the selection criteria.

A total of 74 patient files were studied;

- St. Francis Hospital Nsambya – 47 patients (63.51%)
- Uganda Martyrs Hospital Lubaga -17 patients (22.97%)
- Mengo Hospital – 10 patients (13.51%)

3.4 Sample Size

Sample size was not computed, since the study was time bound and included all patients who satisfied the inclusion criteria.

$$n_c = D\frac{z^2 * p(1-p)}{\delta^2} = \frac{1.96^2 * 0.153(1-0.153)}{\delta^2}$$

Where;

n_c is the sample size to be calculated.

z is standard normal deviate at 95% confidence interval being 1.96;

p is the mortality associated with pelvic fracture i.e. 13.5% (Demetriades et al., 2002)

$\boldsymbol{\delta}$ is the expected error of precision for the study set at 5%

$$n_c = 1.2 * \frac{1.96^2 * 0.153(1 - 0.153)}{0.05^2} = 239$$

However, the population of pelvic fractures in the three urban PNFP hospitals is N

$$n_f = \frac{n_c}{1 + \frac{n_c - 1}{N}} = \frac{239}{1 + \frac{239 - 1}{105}} = 73\ patients$$

3.5 Sampling Techniques

All pelvic fracture patients who received care at three urban PNFP hospitals of St. Francis Hospital Nsambya, Uganda Martyrs Lubaga Hospital and Mengo Hospital within the defined period (January 2014 – December 2018) and fulfilled the inclusion criteria below were enrolled into the study

3.6 Selection criteria

3.6.1 Inclusion criteria

i. Records of patients who had Hospital showing they had been managed for pelvic fracture, at St. Francis Nsambya, Uganda Martyrs Lubaga and Mengo Hospitals between January 2014 and December 2018 inclusive.

ii. Records of pelvic fracture patients admitted from the Emergency Unit or OPD to the wards or ICU.

3.6.2 Exclusion criteria

i- Pelvic fracture patients who were attended to St. Francis Nsambya, Uganda Martyrs Lubaga and Mengo Hospitals as out-patients.

3.7 Data Collection Methods and Instruments

Approval of both the Surgery Department and the Institutional Review Boards (IRBs) to carry out the study were obtained and permission to access patient records was also obtained from the Hospital Management.

we utilised the institutions' admission record books to identify patients between January 2014 and 2018 inclusive.

A research Assistant was trained by the Principal Investigator on how to Identify and retrieve the patient files needed for the study. Files were then retrieved and reviewed by the principal Investigator.

Data collection was done by the Principal Investigator using data abstraction sheets which were pre-tested prior to full use and necessary adjustments were made.

3.8 Quality Control Methods

For purposes of ensuring internal and external validity of the study, the following precautions were taken:

1- The data extraction sheet was pre-tested before commencement of the study.
2- The data extraction sheet was cross checked to ensure completeness before the investigator returned patients' charts to the Records Department.
3- The collected data was double checked before entry into the software (EPI – DATA version 3.4) to minimize the errors that would have occurred as the data was being entered.
4- Accurate collection and recording of data by the principal investigator and back-up of collected data on different external hard drives was done.
5- Data analysis was done with the assistance of a Bio-Statistician.

3.9 Data Management and processing

Socio-demographic, Laboratory, clinical and other information were obtained through a review and abstraction of data from the patient's medical records. Data obtained was checked and cleaned, organized, coded and double entered into EPI-DATA version 3.4. It was securely stored on more than one electronic device. Confidentiality was ensured through the whole process of its management and analysis.

3.10 Study variables

Outcome variable: The main outcome (dependent) variable was based on patient's condition at admission categorized as good condition or poor condition. Poor condition was defined as having a poor heart rate (higher HR<60/lower HR>100) or poor systolic blood pressure (higher sbp>139 /lower sbp<90) or poor diastolic blood pressure (higher dbp>99 /lower dbp<60) or severe TBI (Glasgow Coma Scale: GCS<9) on admission, received more than two units packed red blood cells and those who had died. The existence of any of these criteria qualified the case to be poor condition.

Independent variables: Variables of interest included age, gender, co-morbidity mode of transportation and duration and care provided, mechanism of trauma (motor vehicles or falling down), initial vital signs(blood pressure, heart rate, respiratory rate, O_2 saturation),laboratory data within 24 hours of admission (HB, platelets, WBC, electrolytes and creatinine), associated injuries (head trauma, thoracic trauma, abdominal trauma), transfusion and patients' outcomes (transfer to ward, transfer to ICU, transfer to operation room (OR/surgery), and mortality(death)), duration of hospital stay, GCS, IV Fluids on day 1, and type of fracture

3.11 Tile's classification and categorizing injuries

Tile's alphanumeric system of modified Pennel classification and categorization of the injuries i.e. "stable" and "unstable" was used to determine patterns of injuries (Young and Resnik, 1990). According to Tiles classification Fracture pattern was classified as follows:

Type A: Stable fracture: These are the fractures with intact soft tissues around the pelvis, not disrupting the ligaments. It includes — avulsion fractures and transverse fracture of sacrum and coccyx.

Both Tiles type B and Type C injuries were considered as unstable fractures. Type B is regarded as rotationally unstable, but vertically stable. These fractures are rotationally unstable and vertically stable. There is less than 1 cm rotation of the hemi-pelvis. These types of injuries are caused by external or internal rotational forces. The external rotational forces produce 'open book' injury pattern. There is disruption of pubis symphysis associated with unilateral or bilateral SI joint disruption. The posterior SI ligaments remain intact, thus the pelvis is

vertically stable. Type C is rotationally and vertically unstable. These injuries are characterized by disruption of posterior SI ligaments as well as pelvic floor, this result in gross displacement of pelvis. These injuries are due to VS forces, resulting in the mark displacement of the SI joint. There is complete disruption of both SI and sacrotuberous ligament leading to rotationally and vertically unstable fracture pattern. Orthopedic Trauma Association Classification is a further modification of the

3.12 Data Analysis

Data was analyzed using STATA version 14.0 (STATA Corporation, Houston, Texas). Univariate analysis was carried out with continuous variables presented as means and standard deviation while categorical variables were described by frequency counts and their percentages.

Specific objective one was answered using Tiles patterns of injury classification and based on whether the patient had a stable injury or an unstable injury.

Specific objective three was based on both bivariate and multivariate analysis using poor condition. At bivariate analysis, independent variables were compared with the outcome variable and variables found to be associated with outcome at p-values of less than 5% identified. To establish poor outcome determinates of Pelvic fractures, variables from the univariate and bivariate analyses with p-value of less than 0.25 as well as those considered to be of clinical importance based on previous studies were included in Multivariable regression Model. A backward stepwise elimination method was employed to identify predictors. Regression results were expressed as Odds Ratios and their 95% confidence intervals (CI). A 2-sided p-value of less than 0.05 was considered significant.

3.13 Ethical Considerations

Approval to conduct the study was obtained from the department of general surgery at St. Francis Hospital Nsambya Research Ethical Committee prior to commencement of data collection. The PI also obtained waiver consent from the Research and Ethics Committees of all the three Hospitals of St. Francis Nsambya, Lubaga and Mengo. The study did not involve any additional investigation or any significant risk. It did not cause economic burden to the patients. Data was collected by approved data collection forms.

3.14 Limitations of the Study

It was anticipated that this study may be limited to variable degrees of accuracy depending on the level of accuracy in documentation in patients' files and this was actually a challenge: some files didn't have documentation of SpO_2, pulse, BP and Laboratory results.

Vital parameters such as ISS and Tile's classification of pelvic fracture were not available in patient files, to enrich our study by establishing whether a poor outcome in patients managed operatively was due to severity of injury or other factors such as timing of operation.

Chapter 4

RESULTS

4.1 Baseline Characteristics

Table 1: Baseline of characteristics of patient admitted with traumatic pelvic fractures among trauma patients admitted at St. Francis Nsambya, Uganda Martyrs Lubaga and Mengo Hospitals.

Characteristics	General Nº (%)
Age	
Mean(SD)	37.4(17.6)
95%CI	33.3 - 41.5
Gender	
Male	40 (54.0)
Female	34 (46.0)
Mechanism of Trauma	
Fall	6 (8.57)
Gun shot	2 (2.86)
Blunt object	3 (4.29)
RTA	59 (84.29)
Heart rates (per min)	
Normal	52 (78.79)
Poor HR	14 (21.21)
Missing	8 (10.81)
SBP (mmHg)	
Normal SBP	52 (70.27)
Poor SBP	18 (24.32)
Missing	4 (5.41)
DBP (mmHg)	
Normal DBP	53 (71.62)
Poor DBP	17 (22.97)
Missing	4 (5.41)
Blood Transfusion	
≤ 2 Unit	13 (17.57)
> 2 Units	6 (8.11)
No transfusion	55 (74.32)
Presence of associated injuries	
No	37 (50.00)
Yes	37 (50.00)
Patient status at admission	
Good condition	40 (54.05)
Poor condition	34 (45.95)

In the study, it was observed that the mean age of the study population was 37.4 years with a standard deviation of 33.3-41.5 at a 95% confidence interval. It was also observed that 79.73% of the participants were less than 50 Years of age and the remaining 20.27% were above 50 years. It was also observed that 54.0% of the participants were of the Male gender and the remaining 46.0% of the participants were female. The study also observed that 84.29% of the reported traumas were as a result of Road traffic involvement, 8.57% resulted from falls and the remaining 2.86% and 4.29% were as a result of Gun shots and Blunt Object Trauma respectively.

During the study, it was also observed that 74.32% of the study participants were not transfused and the remaining 25.68% were transfused (17.57% <2 units, 8.11% > 2units).

On assessment of associated injuries, 50% of the participants reported presence of associated injuries and the other 50% reported no associated injuries

Table 2: Clinical outcomes among trauma patients admitted with traumatic pelvic fractures at St. Francis Nsambya, Uganda Martyrs Lubaga and Mengo Hospitals.

Characteristics	**General Nº (%)**
Outcome	
Operation	
No	42 (56.76)
Yes	22 (29.73)
Missing	10 (13.51)
Admission to ICU	
No	61 (82.73)
Yes	6 (8.11)
Missing	7 (9.46)
Hospital LOS (days)	
mean(sd)	7.11(7.24)
95%CI	5.27-8.95
LOS category	
<1 week	36 (48.65)
≥1 week	26 (35.14)
Missing	12 (16.22)
Survival Status	
Survived	71 (95.95)
Died	2 (2.7)
Missing	1 (1.35)

On assessment of the outcomes the mean length of hospital stay was 7.1 days with a standard deviation of between 5.3-9.0 days.48.7% of the participants stayed for less than one week and 35.1% stayed in hospital for more than one week.56.8% of the participants did not undergo operation, 29.7% had operation and the remaining 13.5% had missing data.8.1% of the participants were admitted to ICU, 82.7% were not admitted and 9.5% of the participants had missing data. On survival status outcome, 96% of the participants survived, 2.7% of the participants died and 1.4% had no recorded outcome.

4.2 Patterns of Pelvic Fractures

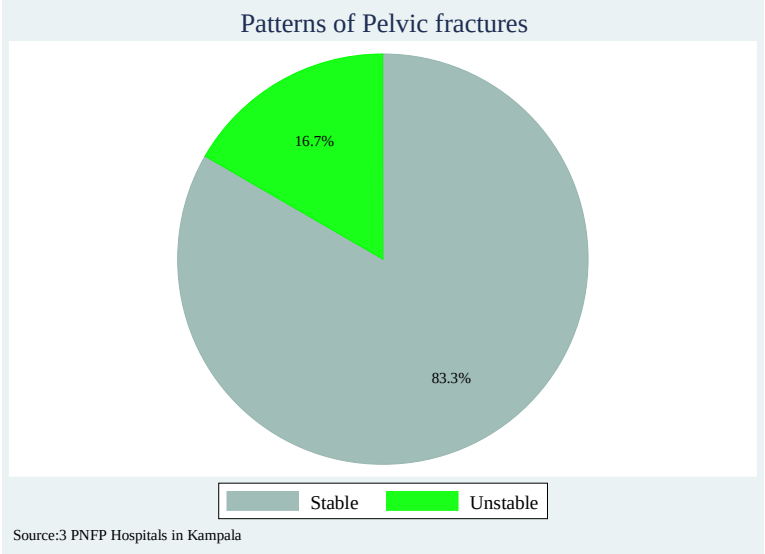


Figure 2: Graph showing patterns of pelvic fractures among patients of the 3 PNFP hospitals.

4.3 Associated Injuries

Of the participants who reported associated injuries, 52.4% reported involvement of the extremities, 25.4% reported Head and neck involvement, 7.9% reported abdominal involvement, 7.9% reported chest involvement, 4.8% reported pelvic region involvement and the remaining 1.6% reported spinal involvement.

Table 3: Injuries associated with pelvic fracture among patients admitted at St. Francis Nsambya, Uganda Martyrs Lubaga and Mengo Hospitals.

Body part	Frequency	Percentage	Over-all Percentage
Abdomen			
Perforated Colon	1	20%	**5** (7.94%)
Blunt Abdominal Trauma	3	60%	
Spleen Rapture	1	20%	
Chest			
Fracture Rib	2	40%	**5** (7.94%)
Fracture Clavicle	2	40%	
Scapula	1	20%	
Extremity			
Foot	1	3%	
Fracture Femur	2	6%	
Fracture Fibula	2	6%	
Fracture Tibia	7	21%	**33**(52.38%)
Fracture Trochanter	1	3%	
Fracture Ulna Radius	1	3%	
Humeral Fracture	1	3%	
STI	18	55%	
Head & Neck			
TBI	11	69%	
Neck Fracture	2	13%	**16**(25.40%)
Head Fracture	2	13%	
Contusion	1	6%	
Pelvis			
Bladder Laceration	1	33%	**3** (4.76%)
Bladder Rapture	1	33%	
Hip Laceration	1	33%	
Spine			**1** (1.60%)
Lumbar 1 Bust Fracture	1	100%	

On assessment of specific body involvement, of the 7.9% of the participants who reported. Abdominal region involvement, 67% were rib fractures and 20% were perforated colon, Blunt abdominal Trauma and Spleen rapture independently. Of the 7.9% who reported chest region involvement, 67% were of clavicle fracture and 33% were of the scapula.

Of the 52.4% who reported involvement of the extremities, 55% reported soft tissue injuries, 21% reported fracture of the Tibia and 6% reported Fibula fractures. Of the 25.4% of the participants who reported Head and neck fractures, 69% were TBIs and 6% were contusions, also with Neck and Head fracture each contributing to 13% of the injuries.

Factors associated with poor outcomes of pelvic factures

On bivariate analysis, it was observed that participants who underwent operations were 2.86(1.162-7.06) times more likely to have poor pelvic fracture outcomes compared to those who didn't have operation at a p-value of 0.022. It was also observed that participants who were admitted in ICU were 3.05(1.26-7.38) times more likely to have poor pelvic fracture outcomes compared to those who were not admitted to ICU at a p-value of 0.013 and a 95% confidence interval.

Table 4: Bivariate analysis of characteristics of patient admitted with traumatic pelvic fractures at St. Francis Nsambya, Uganda Martyrs Lubaga and Mengo Hospitals.

Characteristics	General Nº (%)	Condition at admission		Bivariate	p-Value
		Good (n=56)	Poor (n=17)	cOR(95%CI)	
Age group					
< 50 yrs	59 (79.73)	45 (80.36)	14 (82.35)	1	1
50+ yrs	15 (20.27)	11 (19.64)	3 (17.65)	0.9 (0.298-2.74)	0.857
Gender					
Male	40 (54.0)	32 (57.14)	8 (47.06)	1	1
Female	34 (46.0)	24 (42.86)	9 (52.94)	1.36 (0.589-3.16)	0.469
Mechanism of Trauma					
Non RTA	6 (8.57)	9 (17.31)	1 (5.88)	1	1
RTA	59 (84.29)	73 (82.69)	16 (94.12)	2.71 (0.398-18.49)	0.308
Type of fracture					
Stable	60 (83.33)	46 (83.64)	13 (81.25)	1	1
Unstable	12 (14.00)	9 (16.36)	3 (18.75)	1.13 (0.378-3.41)	0.822
Associate injuries					
No	37 (50.00)	31 (55.36)	5 (29.41)	1	1
Yes	37 (50.00)	25 (44.64)	12 (70.59)	2.34 (0.909-6)	0.078
Heart rates (per min)					
Normal	52 (78.79)	41 (83.67)	11 (68.75)	1	1
Poor HR	14 (21.21)	8 (16.33)	5 (31.25)	1.82 (0.76-4.35)	0.179
SBP (mmHg)					
Normal SBP	52 (70.27)	42 (80.77)	10 (58.82)	1	1
Poor SBP	18 (24.32)	10 (19.23)	7 (41.18)	2.14 (0.961-4.77)	0.063
DBP (mmHg)					
Normal DBP	53 (71.62)	42 (80.77)	11 (64.71)	1	1
Poor DBP	17 (22.97)	10 (19.23)	6 (35.29)	1.81 (0.789-4.14)	0.162
Outcome/ Outcome Indicators					
Operation					
No	42 (65.63)	36 (73.47)	6 (40.00)	1	1
Yes	22 (34.38)	13 (26.53)	9 (60.00)	2.86 (1.162-7.06)	0.022
Admission to ICU					
No	61 (82.73)	49 (96.08)	12 (80.00)	1	1
Yes	6 (8.11)	2 (3.92)	3 (20.00)	3.05 (1.26-7.38)	0.013
LOS category					
≤1 week	36 (48.65)	29 (59.18)	6 (50.00)	1	1
>1 week	26 (35.14)	20 (40.82)	6 (50.00)	1.35 (0.486-3.73)	0.568

On multivariate analysis, It was observed that participants who had a poor heart rate were 1.82(0.76-4.35) times more likely to have a poor outcome as compared to those with a normal heart rate at a p-value of 0.008 and 95% confidence interval. It was also observed that participants who underwent surgical operation were 8.38(2.37-29.64) times more likely to have poor outcomes resulting from trauma as compared to those who did not undergo operation at a p-value of 0.001 and 95% confidence interval.

Table 5: Determinants of poor outcome among patients with traumatic pelvic fractures admitted at St. Francis Nsambya, Uganda Martyrs Lubaga and Mengo Hospitals.

Characteristics	Condition at admission Good (n=56)	Poor (n=17)	Bivariate cOR(95%CI)	p-Value	Multivariate aOR(95%CI)	p-Value
Age group						
< 50 yrs	45 (80.36)	14 (82.35)	1	1	1	1
50+ yrs	11 (19.64)	3 (17.65)	0.9 (0.298-2.74)	0.857	1.39 (0.33-5.79)	0.655
Gender						
Male	32 (57.14)	8 (47.06)	1	1	1	1
Female	24 (42.86)	9 (52.94)	1.36 (0.589-3.16)	0.469	2.1 (0.76-5.8)	0.151
Mechanism of Trauma						
Non RTA	9 (17.31)	1 (5.88)	1	1	1	1
RTA	73 (82.69)	16 (94.12)	2.71 (0.398-18.49)	0.308	3.44 (1.04-11.73)	0.073
Associate injuries						
No	31 (55.36)	5 (29.41)	1	1	1	1
Yes	25 (44.64)	12 (70.59)	2.34 (0.909-6)	0.078	0.62 (0.17-2.24)	0.467
Heart rates (per min)						
Normal	41 (83.67)	11 (68.75)	1	1	1	1
Poor HR	8 (16.33)	5 (31.25)	1.82 (0.76-4.35)	0.179	**5.95 (1.59-22.28)**	**0.008**
SBP (mmHg)						
Normal SBP	42 (80.77)	10 (58.82)	1	1	1	1
Poor SBP	10 (19.23)	7 (41.18)	2.14 (0.961-4.77)	0.063	0.75 (0.28-2.04)	0.579
DBP (mmHg)						
Normal DBP	42 (80.77)	11 (64.71)	1	1	1	1
Poor DBP	10 (19.23)	6 (35.29)	1.81 (0.789-4.14)	0.162	0.3 (0.08-1.08)	**0.065**
Outcome/ Outcome Indicators						
Operation (%)						
No	36 (73.47)	6 (40.00)	1	1	1	1
Yes	13 (26.53)	9 (60.00)	2.86 (1.162-7.06)	0.022	**8.38 (2.37-29.64)**	**0.001**
Admission to ICU (%)						
No	49 (96.08)	12 (80.00)	1	1	1	1
Yes	2 (3.92)	3 (20.00)	3.05 (1.26-7.38)	0.013	1.22 (0.38-3.87)	0.742

Chapter 5
DISCUSSION

5.0 Introduction

A total of 74 patient files were studied;

- St. Francis Hospital Nsambya – 47 patients (63.51%)
- Uganda Martyrs Hospital Lubaga -17 patients (22.97%)
- Mengo Hospital – 10 patients (13.51%)

The patterns of pelvic fractures as observed in this study were Stable (83.3%) and unstable (14.0%). Two (2.7%) of patient files had no documentation of any pattern of fracture. This is in contrast to Dr.Wachira's findings in which unstable pelvic fractures accounted for 87.1% (Kenyatta University Hospital). Another study conducted in Uzbekistan by **Akbar B Tilyakov** and others also revealed that most pelvic fractures (65.3%) were unstable. These contrasts are probably due to some patients with unstable pelvic fractures not reaching Hospital or more being taken strait to the National Referral Hospital following various accidents.

Outcome determinant for pelvic fractures in this study included Heart rates at admission (p=0.008) and Operation (surgical intervention) (p=0.001).

5.1 Patterns of pelvic fractures

The study reports an overall stable and unstable pelvic fracture of 83.3% and 14.0% respectively with a slight male preponderance recorded for both stable i.e. male 55% to female 45% and unstable i.e. male 58.3% to female 41.7% fractures. This pattern of male preponderance is also in keeping with the fact that more male individuals seem to be involved in more risky behavior than their female counterparts. Noteworthy is the fact that majority of pelvic fractures occurred below age 50 years (79.73%), when individual are usually more active.

The current result were similar to those reported by Marvin Tile, where majority (> 60%) of pelvic fractures in major trauma centers were stable (Tile, 1988). The results in this study were also similar to Revista Brasileira's with 54% predominance of stable pelvic fractures (Pereira et al., 2017). Another study carried out in Netherland by Hermans et al. (2017) reported 25.% stable compared to 74.5% unstable fractures among patients with pelvic fractures in Netherlands.

It was also observed that the predominant mechanism of trauma in pelvic fractures was RTC (82.6%). Results from this study are similar to Singapore results where road traffic accidents (52%) and in UK where incidence of RTC was 62.9% (Ooi et al., 2010, Giannoudis et al., 2007). In the Kenyatta University study RTC contributed to 87.9% of all reported pelvic fractures (Wachira Victor Gioko, 2017). These differences could be accounted for by the differences in geographical settings, level of emergency services and level of specialization.

5.2 Associated injuries

In this study, it was observed that the most common injuries associated with pelvic fracture were in extremities (52.38%) followed by the head and neck region (25.40%) and then abdomen and chest regions (7.94%). Similar to our study results, Ooi et al reported extremity injuries to be the most common among patients with pelvic fractures (Ooi et al., 2010). However, our results differ from those reported in a UK study in which extremity fractures(7.8%) was fourth most common injuries among patient admitted with pelvic fractures (Giannoudis et al., 2007). These differences in findings are probably due to the differences in pedestrian and motorist and vehicle occupant populations.

Head and neck: In this study we observed that the head and neck injuries were the 2nd common injuries associated with pelvic fractures with 25.4%. Similar results to those obtained in this study have been reported by Giannoudis et al. (2007). However, our findings differ from those reported in a study carried out by Ooi et al. (2010) in which they reported that presence of concurrent head, face and chest injuries were third most common representation of 38% of all injuries (Ooi et al., 2010).

Among the head and neck region, TBI was the most observed single associated injury (69.0%). This result is similar in ranking to that reported by Dr. Wachira of Nairobi University with (23.9%). These results differ from those reported in a study carried out in the UK in which pelvic injuries were second most commonly head injuries (16.9%) (Giannoudis et al., 2007)

Our study reported Abdomen and Chest injuries to be third most common associated injuries. However, the UK study reported chest injuries to be the most commonly (21.2%) whereas in a Singapore study abdomen and chest injuries (33.2%) were the second most common associated with pelvic fractures (Giannoudis et al., 2007, Ooi et al., 2010).

5.3 Determinants of poor outcome

Surgical Interventions

The results indicated that patients who underwent surgical intervention were (aOR 8; 95% CI of 2.37 to 29.64) more likely to have a poor outcome compared to those who never underwent surgical intervention. The study findings are similar to results reported in another study in which there was an increased risk of road traffic crashes involving pedestrians of (aOR 6.36, 95% CI: 3.32–12.17) and being struck by a motor car of (aOR 3.95, 95% CI: 2.09–7.47) (Sanyang et al., 2017). This study's results are also similar to those reported by Paydar and others in Iran in which higher rate of surgical interventions ($p<0.001$) predicted poor outcomes among patients with pelvic fractures (Paydar et al., 2017). However, further evaluation to establish whether the actual reason for the poor outcomes observed in the operatively managed patients was due to severity of injury or other factors such as timing of operation which was not done due to absence of required parameters such as ISS.

Elevated Heart Rates

The second factor significantly associated with poor outcome was having elevated heart rate ($p = 0.008$). In their study Paydar and others also noted that poor conditions among pelvic fracture patient was significantly associated with elevated heart rate ($p=0.002$) (Paydar et al., 2017).

Considering that all other studies reviewed found blood pressure to be outcome predictors as well as pulse rate, it is probable that the statistical insignificance of the SBP and DBP was probably due to the deficit of these parameters in a number of patient files.

Limitations of the Study

The limitations in this study were to variable degrees, and ranged from poor documentation, non-standardisation of diagnosis, through to poor filing and consequent failure to retrieve some of the files, up to 33% in the case of St. Francis Nsambya and Mengo Hospitals. The record management style in Uganda Martyrs Hospital Lubaga, with both digital and manual systems and few handlers seemed to yield better results (100%).

Chapter 6

CONCLUSION AND RECOMMENDATION

6.1 Conclusions

Stable fractures were the most commonly reported pelvic fractures with a higher percentage among male individuals less than 50 years, predominantly caused by RTC.

The most commonly associated injuries to pelvic fractures in this study involved the extremities followed by head and neck region.

Poor outcome was observed in patients with pelvic fractures, who had elevated heart rate at presentation and associated with those who required or had undergone operational interventions.

6.2 Study limitations

- Under documentation in patient files left out some useful parameters such as ISS which should have enriched this study. None of the patient files had any documentation of ISS,
- Failure to standardise diagnoses limited the fracture patterns to stable and unstable, which left out vital details which should have been well spelt out if say Tile's classification was employed as was done in other similar studies: this would further help in deeper analysis of data.
- Up to 33% less files were reviewed at St. Francis Nsambya and Mengo Hospitals due to pitfalls in record keeping.

6.3 Recommendations

- Keen attention should be given to assess and address haemodynamic derangements in pelvic fracture patients (elevated heart rate).
- Precautions should be taken to closely monitor and appropriately intervene in the care of pelvic fracture patients who may require or have undergone operational interventions.

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APPENDICES

APPENDIX I: INFORMATION SHEET.

Poor Outcome Determinants of Pelvic Fractures at St. Francis Nsambya, Uganda Martyrs Lubaga and Mengo Hospitals.

Name of Principal Investigator: Dr. Osuta Hope (MBChB)

Name of the Organization: St. Francis Hospital Nsambya

Introduction

We conducted a study to determine the outcome determinants of pelvic fracture patients. The research team included one principal investigator and two research assistants.

Significance of the research study:

This study could become part of the reference documents for strategic planning and clinical decision making in the management of pelvic fracture patients.

It will be a reference document for similar/related future studies.

Potential Risks and Discomforts:

There are no anticipated risks or discomfort to the patients since it's a retrospective study.

Potential benefits to subjects and/or to the society:

- More focused patient care
- Appropriate resource allocation

Confidentiality:

Any information that is obtained in connection with this study and that can be identified with the patient will remain confidential. The information collected about the patient will be coded using numbers.

Principal Investigator:

Name: *Dr. Osuta Hope*

Cell phone: *+256(0)772534402*

E-mail: *homesuta@gmail.com*

APPENDIX II: DATA ABSTRACTION SHEET

Code:	1	2	3	4	5	6	7	8	9	10	11	12
Ipn^{o}:												
Age												
Gender:												
Co-morbidity												
Mechanism of Trauma												
Fracture Type												
ISS												
Hb (g/dl)												
WBC(x10^{3}/ml)												
Platelets (x10^{3}/ml												
Electrolytes (mmol/l) Na^{+}/K^{+}												
BUN												
Creatinine												
ICU Admission/Transfer												
Ward Admission												
OR/ Surgery												
Duration of Hospitalisation												
Associated Injuries												
Blood Transfusion on day 1												
IV Fluids on day 1												
Admission GCS												
Admission Pulse												
Admission Systolic B/P												
Admission Diastolic B/P												
Admission Respiratory Rate												
Admission SpO_2												
Death												

APPENDIX III: WORK PLAN OF THE STUDY

Activity	**2018**				**2019**				
Proposal writing	**Sept**	**Oct**	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**April**	**May**
Presentation at the Department	X	X							
Presentation at the IRB		X							
Training of research assistants		X							
Data collection		X	X	X	X				
Analysis of data					X	X			
Thesis writing						X	X	X	
Thesis defense									X

APPENDIX IV: BUDGET

ITEM	AMOUNT (Ushs)
IRB fees	180,000/=
Stationery and printing	500,000/=
Training	400,000/=
Research Assistants	900,000/=
Data Analysis	1,500,000/=
Total	**3,480,000/=**