PROSPECTIVE COHORT STUDY ON THIRTY DAY OUTCOME OF PERFORATION PERITONITIS AT THE UNIVERSITY TEACHING HOSPITALS, LUSAKA, ZAMBIA

BY

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A dissertation submitted to the University of Zambia in partial fulfilment of the requirements for the award of the degree of Master of General Surgery

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DECLARATION

I, Kizito Mulamba Changachanga Kabongo, hereby declare that the work presented in this research study for the degree of Master of Medicine in General Surgery represents my work and has not been presented either in part or wholly for any other degree and is not being submitted for any other degree at the University of Zambia or any other University.

Signature of candidate: …….. Date: …….

APPROVAL

This dissertation of Dr. Kizito Mulamba Changachanga Kabongo has been approved as partial fulfilment of the requirements for the award of the Master of Medicine in General Surgery by the University of Zambia.

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ABSTRACT

Perforation peritonitis is a common surgical emergency seen by surgeons; it remains a life threatening condition with high morbidity and mortality. At the University Teaching Hospitals (UTH), the morbidity for gastro-duodenal perforation has not been studied. Furthermore, based on the available literature at the main referral centre in Zambia the outcome of perforation peritonitis following jejunal, ileal, colonic perforation, with the use of the Physiological and Operative Severity Score for enUmeration of Mortality and Morbidity (POSSUM) scoring system, was unknown. The study aimed to determine the site of perforation, the post-operative outcomes of leakage, wound dehiscence, re-laparotomy and mortality in relation to the site of perforation, and related the POSSUM score to the outcome.

This was a prospective observational study conducted at the Department of Surgery of the University Teaching Hospitals, Lusaka from July 2018 to March, 2019. During this period a total of 100 patients undergoing exploratory laparotomy for spontaneous perforation peritonitis were included. The morbidity and mortality risks were calculated using the POSSUM and P-POSSUM.

Sites of perforation were:-Gastric (n=49) followed by ileal (n=36), colonic (n=8), jejunal (n=3) duodenal (n=1), combined ileal and colonic (n=1), unidentified (n=1) and urinary bladder (n=1). The mean age was 37.24 (range 18 to 78 years). There were 77 males and 23 females ratio 3.34:1. Thirty six died (36% mortality rate) in the post-operative period and morbidity rate was 17.19%. Post-operative outcomes included leak 9%, wound dehiscence 3%, and re-laparotomy 17%. Thirty four percent of patients needed admission to intensive care unit (ICU) and twenty nine out of thirty four (85.29%) patients who were admitted to ICU died. Hospital stay was 9.53±6.86 days. The most common cause of death was septic shock in nineteen (52.78%) followed by sepsis, and acute kidney injury. The predicted morbidity score correlated positively with size of perforation and the POSSUM score, although not statistically significant. Number of perforation, site of perforation, physiological and operative score positively correlated with mortality score and was statistically significant ($p<0.05$).

Gastric perforation was the leading cause of perforation peritonitis, with the highest morbidity and mortality at UTH; followed by the ileum, colon, jejunum, duodenum and lastly, urinary bladder. The commonest postoperative outcome was re-laparotomy followed by leak and abdominal wound dehiscence. The commonest cause of mortality in perforation peritonitis was septic shock followed by sepsis. The POSSUM score significantly predicted mortality in perforation peritonitis in patients at the UTH. However, it could not significantly predict the outcome of leak, wound dehiscence and re-laparotomy.

Keyword: *Perforation peritonitis, emergency laparotomy, outcome*

DEDICATION

This project is dedicated to my wife Betty who has been supportive and encouraging during the period of the study, and my childrens Dinanga, Dihinga, Disanka and Dibenesha who have been denied quality and family time with the father so that I could work on this study.

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ABBREVIATIONS AND ACRONYMS

AKI	Acute Kidney Injury
APACHE	Acute Physiology And Chronic Health Evaluation
CRP	C–Reactive Protein
CT	Computer Tomography
CXR	Chest X-Ray
DIC	Disseminated Intravascular Coagulopathy
ECG	Electrocardiogram
GIT	Gastrointestinal Tract
ICU	Intensive Care Unit
IL	Interleukin
MOF	Multiple organ failure
MPI	Mannheim Prognostic Index
POSSUM	Physiological and Operative Severity Score for enUmeration of Mortality and Morbidity
PPI	Proton Pump Inhibitor
PUD	Peptic Ulcer Disease
SD	Standard Deviation
TNF	Tumour Necrosis Factor
UNZA	University of Zambia
UTH	University Teaching Hospitals

DEFINITION OF TERMS

Gastrointestinal tract : is a digestive hollow organ which starts from the cardiac end of the stomach and ends at the termination of the anal canal. The areas considered in this study are the stomach; duodenum; jejunum; ileum and colon.

In-hospital mortality : is death occurring during the hospital stay.

Laparotomy : is a surgical procedure to gain access into the abdominal cavity or opening of the peritoneal cavity by incising through the abdominal wall

Leak : For the purposes of this study a *leak* has been defined as discharge of gastrointestinal contents from a surgical anastomosis or repair *site*. Such a defect results in communication between the intra- and extra-luminal compartments (Rahbari et al., 2010).

Morbidity : is the term used to describe deterioration in the health status of the patient within one month following surgery

Outcome : (for the purpose of this study) is defined as *leak, wound dehiscence, re-laparotomy* and *mortality*.

Re-laparotomy : is a repeated exploratory operation of the abdominal cavity in postoperative period. It can be early *re-laparotomy* within 14 days after initial abdominal operation or late that is 14 days after the initial abdominal operation. (Yovtchev et al. 2010; Mik et al., 2014).

Secondary Peritonitis : is peritonitis secondary to perforation of a hollow organ with resultant spillage of the contents. This project will study perforation peritonitis which falls under the designation of secondary peritonitis associated with perforation (Johnson, Baldessarre, & Levison, 1997).

Sepsis : was defined as clinical demonstration of features of systemic body response such as high/low temperature, raised heart rate, difficult breathing or raise respiratory rate, and altered mental state as a result of infectious micro-organism spillage into the abdominal cavity following gastrointestinal perforation. It can lead to multi-organ failure and death.

Septic shock : is a subset of sepsis in which underlying circulatory and cellular/metabolic abnormalities are profound enough to substantially increase *mortality*. Clinically, it is sepsis with persisting hypotension requiring vasopressors despite adequate volume resuscitation (Singer et al., 2016).

Site : is the stomach, duodenum, jejunum, ileum and colon. Whereas a perforation at one of these *sites* is further subdivided into anterior, posterior for the stomach.

Wound dehiscence : is deep disruption or breakdown of a wound (Eisenstat & Hoerr, 972). In the study we restricted ourselves to abdominal fascial *wound dehiscence* after laparotomy.

CHAPTER 1 : INTRODUCTION

1.1 Background

Peritonitis is inflammation of the peritoneal cavity, and perforation peritonitis is one of the commonest surgical emergencies seen in surgery all over the world as well as in Zambia. Perforation peritonitis is categorised as *secondary peritonitis* and follows perforation of a part of the gastrointestinal tract (GIT) resulting in spillage of contents into the peritoneal cavity. Various aetiologic causes include spontaneous perforation of the gastrointestinal tract, infective causes, trauma, anastomotic disruption, intestinal ischaemia, and following abdominal surgery (Malangoni, & Inui, 2006). Such perforations result in generalized peritonitis and sepsis with a high morbidity and *mortality* (Ali & Gali, 2010; Bali et al., 2014). Our study concentrated on perforation peritonitis which fell under *secondary peritonitis.*

1.2 Statement of the Problem

Perforation peritonitis is a life threatening emergency condition, and has high morbidity and *mortality* rate. The number of patients admitted to the University Teaching Hospitals (UTH) Surgery Department for emergency laparotomy and peritonitis remains high. Peritonitis is the second commonest cause of *mortality* in UTH main intensive care unit (ICU) (UTH ICU audit, 2017). The causes, frequencies and surgical outcome of perforation peritonitis vary. The overall reported *mortality* rate is from 6 to 27%. But for Lusaka, Zambia the *mortality* rate for gastro-duodenal perforation peritonitis is high at 37 %, and the morbidities such as *wound dehiscence, leakage* and *re-laparotomy* at first admission have not been documented to the best knowledge of the researcher.

Based on the UTH publications only histological pattern for ileo-caecal perforation and use of rapid diagnosis of intestinal tuberculosis was documented. There is however, paucity of information at the UTH on post-operative outcomes in patients with peritonitis related to gastro-duodenal, jejunal, ileal, and colonic perforations and no data on the combined use of a scoring system.

1.3 Study Justification

The number of patients presenting to the surgical emergency department with perforation peritonitis is high. Perforation peritonitis has high rate of post-operative outcomes. The overall perforation peritonitis *mortality* ranges from 6 to 27%. In Zambia, with reference to the UTH, in 2010 the *mortality* rate for peritonitis due to peptic ulcer disease (PUD) was 37% (Sondashi, Odimba & Kelly, 2011). Although only factors associated with PUD and *mortality* rate were documented, no post-operative outcomes such as *wound dehiscence, leakage* and *re-laparotomy* were studied.

With regard to intestinal perforation, the post-operative outcome of intestinal perforation peritonitis had not been established at the UTH. The available literature looked at the histological diagnosis of ileo-caecal perforation with emphasis on rapid diagnostic test for ileal tuberculosis but post-operative outcomes of *leakage, wound dehiscence, re-laparotomy* and *mortality* of intestinal perforation peritonitis were not documented.

The study will highlight the outcome of perforation peritonitis by anatomical *site* at the University Teaching Hospitals, Surgery Department, Zambia. Irrespective of the factors which could be contributing to morbidity and *mortality*; knowledge of the outcome of a patient undergoing emergency laparotomy for perforation peritonitis with the use of a scoring system will aid in surgical decision making. This study addresses the issue.

1.4 Hypothesis/Research Question

What is the outcome of perforation peritonitis at the University Teaching Hospitals, Lusaka, Zambia?

1.5 Objectives

1.5.1 General objectives

To investigate the outcome of perforation peritonitis in patients presenting to the Surgery Department, University Teaching Hospitals, Lusaka, Zambia

1.5.2 Specific objectives

i. To determine the *site* of perforation

ii. To identify and determine the post-operative outcome of *leakage, wound dehiscence, re-laparotomy* and *mortality* in relation to the *site* of perforation following emergency laparotomy for peritonitis secondary to gastro-duodenal, jejunal, ileal and colonic perforations.

iii. Relate the POSSUM score with the post-operative outcome at UTH.

CHAPTER 2 : LITERATURE REVIEW

2.1 Causes of Perforation Peritonitis

Peritonitis can also be classified as diffuse or localised which can lead to intra-abdominal abscess formation. There are many causes of perforation peritonitis, and the profile of causes differ from region to region. The leading cause also differs with geographic location (Samuel et al., 2011).

No single bacterial organism causes peritonitis as several bacteria have been implicated in its aetiology. It is a polymicrobial infection caused by aerobic and anaerobic gram-positive and gram-negative bacteria including Bacteroides species, Streptococcus species, and Escherichia coli (Gauzit et al., 2009).

There are several organs in the abdominal cavity that can be perforated leading to secondary peritonitis; these include the gallbladder, extrahepatic biliary tree, urinary bladder, in addition to the stomach, duodenum, jejunum, ileum and colon.

2.2 Pathophysiology

The peritoneum is an otherwise sterile environment but peritonitis ensues as the serosal membrane lining the abdominal cavity becomes inflamed. Depending on the pathologic irritant, the resulting peritonitis could be infectious or sterile. The factors that influence the physiologic response include properties of the irritant or infecting agent, immune status and the health of the host. When the gastrointestinal tract perforates, bacteria, ingested food, and secretions from the gastrointestinal tract spill into the peritoneal cavity resulting in inflammation of the peritoneum. The presence of bacteria and bacterial products in the abdominal cavity following gastrointestinal perforation triggers local and systemic release of pro- and anti-inflammatory mediators. Mediators released include cytokines, tumour necrosis

factor-alpha (TNF-alpha) and interleukin-6 (IL-6). Peritonitis leads to third spacing of fluid thereby depleting the circulatory volume which in turn leads to hypotension. Renal hypoperfusion due to hypotension can lead to reduced urine output and deranged kidney function. The effect on the bowel is to cause paralytic ileus (Sondashi et al., 2011). When the host defense fail to eliminate the infecting agent abscess formation occurs. Infection in the peritoneal cavity can lead to formation of intra-abdominal abscesses, and severe local and systemic sepsis.

Anatomically, the stomach is from the distal end of the oesophagus to the pylorus where the duodenum commences. The small intestine proper includes the jejunum, ileum and ends at the ileo-caecal valve. The small bowel is approximately seven metres in length and is responsible for breakdown and absorption of food products (Williams, O'Connell, & McCaskie, 2018). The large intestine extend from ileum to the anus and has the caecum, ascending, transverse, descending and sigmoid colon. The colon is approximately one and half metres in length, and perforation peritonitis ensues when any part of the stomach, small intestine or large intestine perforates and spills its content into the peritoneal cavity (William et al., 2018).

2.3 Mechanisms of GIT perforations

Gastrointestinal perforations are caused by several mechanisms (Langell & Mulvihill, 2008), and some of the notable ones are shown in table 2.1.

Table 2. 1: Mechanisms of gastrointestinal perforations

Mechanism	GIT perforation
Foreign body perforation	Ingestion of foreign objects
Loss of gastrointestinal wall integrity	Peptic ulcer (gastric and duodenum), Neoplasm, volvulus
Gastrointestinal ischaemia	Shock, Thromboembolic event, Ischaemic colitis
Invasive non -operative procedures (iatrogenic)	Gastro-duodenoscopy, Laparoscopy, Colonoscopy, Reduction of intussusceptions
Infectious process	Typhoid, Tuberculosis
Infestations	Ascaris, tapeworm
Inflammatory conditions	Crohns, ulcerative colitis
Others	Phytobezoar, strangulated internal hernias

2.4 Presentation and Investigations

Patients with peritonitis present to hospital or health facility as acute abdomen which accounts for up to 40% of all emergency-surgical hospital admissions (Langell & Mulvihill, 2008). At the UTH in Lusaka, 85% of all laparotomies, done a decade ago, were for emergency surgical indications, and about 20% of all laparotomies where for perforation peritonitis (Nthele & Odimba, 2006). Langell and Mulvihill (2008) described acute abdomen as a condition that presents with abdominal pain over a relatively short period of time and usually requires urgent surgery. Patients with perforation peritonitis present with abdominal pain, fever, vomiting, and abdominal distension (Ali & Gali, 2010). On examination, tachycardia, and a raised temperature are common; and the patient may have features of dehydration and shock. Abdominal examination reveals generalised tenderness, rebound tenderness, guarding, rigidity with decreased or absent bowel sounds. The diagnosis can often be made clinically from history and physical examination even before investigations are ordered.

Investigations done in a patient with peritonitis include laboratory tests and radiological imaging. The common radiological studies performed include plain erect chest radiograph

and an abdominal x-ray in the erect or the lateral decubitus position if the patient is unable to stand (Chanda, 2015; Langell & Mulvihill, 2008). The radiographs demonstrate free air trapped in the sub-diaphragmatic region or pneumoperitoneum. However, about 90% of perforation peritonitis demonstrate pneumoperitoneum on preoperative plain upright radiographs, and the positivity rate is lowest for appendicular perforation at 7.69% and highest for gastro-duodenal (GD) perforation at 94.19% (Bansal et al., 2012). The diagnosis of perforation peritonitis can also be made intra-operatively. Other investigative modalities are ultrasonography and computer tomography (CT) scan. The diagnosis of peritonitis is made clinically, and rarely is scanning required as it can delay management. For non-traumatic perforations, biopsy of the perforated ulcer or the edges of the perforation at the time of operation is useful in obtaining histological diagnosis (Chanda, 2015).

2.5 Management of Perforation Peritonitis

Management of perforation peritonitis includes fluid resuscitation, intravenous antibiotics and surgery which traditionally was conducted by open laparotomy only. The surgical therapy of perforation peritonitis is threefold and embraces a laparotomy to eliminate the source of infection, intraoperative peritoneal lavage to reduce bacterial load, and the prevention of infection which could persist or recur (Lamme et al., 2002). Besides laparotomy, diagnostic laparoscopy can be performed for perforation peritonitis. According to Johnson et al. (1997) surgical therapy alone maybe adequate in healthy young patients without severe sepsis. During surgery the source of contamination is identified, controlled and peritoneal cavity irrigated with 4–6 litres of warm normal saline. Such intraoperative peritoneal lavage with saline is standard practice during laparotomy for peritonitis (Johnson et al., 1997). A broad spectrum intravenous antibiotic regimen that covers gram-negative, gram-positive, and anaerobic organisms is recommended (Langell & Mulvihill, 2008). In the late 1990 use of laparoscopy to manage perforation peritonitis due to PUD was documented, and laparoscopic

management in perforation peritonitis due to PUD perforation is currently practiced (Robertson, Wemyss-Holden, & Maddernt, 2000). Laparoscopic approach to managing perforation peritonitis is feasible, safe and effective. Laparoscopic treatment of peritonitis is more effective in appendicular and gastro-duodenal perforations than colonic perforation that has higher rate of conversion (Navez et al., 1998).

2.6 Factors influencing outcome

In the early twentieth century, *mortality* rate for peritonitis was as high as 90%, and currently it is still high, ranging from 30% to 50% notwithstanding the advances in resuscitation therapy, radiographic investigations, antibiotics and surgical technique (Langell & Mulvihill, 2008). Perforation peritonitis remains a life threatening condition with high morbidity and *mortality*, and multiple factors that influence the outcome have been documented. Such factors that influence morbidity and *mortality* include advanced age, gender, pre-existing and coexisting diseases, diabetes, poor nutritional status, albumin levels, cholesterol levels, thrombocytopaenia, and leukopaenia. The type and degree of peritoneal contamination and duration of the perforation, presence of local sepsis, presence of septic shock, failure to clear the source of sepsis, *re-laparotomy*, technique, and inadequate antibiotic therapy are other factors which have an influence on outcome. The *site* of perforation is another determining factor; as patients with intestinal perforation have a higher morbidity than patients with gastro-duodenal perforation (Bali et al., 2014).

2.7 Scoring Systems

There are scoring systems used to predict outcome in patients with perforation peritonitis. They include Physiological and Operative Severity Score for enUmeration of *Mortality* and Morbidity (POSSUM), Peptic Ulcer Perforation (PULP), Acute Physiology And Chronic Health Evaluation (APACHE) II, Mannheim peritonitis index (MPI), and Sepsis score of

Stoner and Elebute. APACHE II score can be used to predict outcome, and to evaluate postoperative organ failure (Langell & Mulvihill, 2008; Mulari & Leppäniemi, 2004; Yadav & Garg, 2013). POSSUM has been found to be easy, quick to use and could be employed in both emergency and elective surgeries. It can also be used to predict the outcome in surgery. Besides the surgeon`s abilities, the preoperative and postoperative care, the disease that requires surgery, the nature of the surgical intervention, and the patients physiological status are factors that influence outcome (Copeland, 2002). POSSUM score was developed in 1991 and incorporates the physiological and operative components in predicting morbidity and *mortality* (Clarke et al., 2011). The physiological component has 12 variables while the operative part has 6 variables, each divided into 4 grades with an exponentially increasing score. The minimum physiological score is 12 with 88 as the maximum while the operative score has 6 as the minimum and 48 as the maximum score (Copeland, 2002). POSSUM has been validated in many different types of surgery, and has been applied in orthopaedic, vascular, urology, general surgery, colorectal, oesophageal, laparoscopic and bariatric surgery (Copeland, 2002; Kumar, Suman, Kundan & Kumar, 2016). When predicting *mortality* in patients with perforation peritonitis, POSSUM score was noted to be superior to MPI and sepsis score (Nachiappan, & Litake, 2016). Nevertheless, scoring techniques have drawbacks as POSSUM and MPI can over-predict *mortality* in patients undergoing exploratory laparotomy for perforation peritonitis (Nachiappan, & Litake, 2016).With regard to scoring systems, POSSUM aids in predicting post-operative morbidity and *mortality* in perforation peritonitis. Regardless of its drawbacks POSSUM can be used to identify at risk patients and offers them appropriate care for a better outcome (Chatterjee, & Renganathan, 2015).

2.8 Complications of Perforation Peritonitis

Complications of perforation peritonitis include electrolyte imbalance, abdominal collection, intra-abdominal abscess, wound infection, *wound dehiscence, anastomotic leak, re-*

laparotomy, enterocutaneous fistula, respiratory failure, thrombotic episodes due to lengthy inpatient management and *mortality* (Ali & Gali, 2010; Bali et al., 2014; Singh, Ram, & Khanna, 1998). The overall perforation peritonitis *mortality* rate ranges from 6 to 27% (Bali et al., 2014). In Zambia, Sondashi et al. (2011) found the *mortality* rate following gastric perforation peritonitis to be 37%. However, in India the rate as low as 7% has been documented (Bali et al., 2014). Elective surgery has better postoperative outcome compared to emergency surgeries, and emergency major bowel surgery has one of the highest *mortalities* (Clarke et al., 2011).

2.9 Geographic Variations of Perforation

Perforation peritonitis displays geographical variations. The pattern of gastrointestinal perforation peritonitis is different from region to region (Bali et al., 2014). According to Bali et al. (2014) in India peptic ulcer perforation was the commonest cause of perforation peritonitis followed by perforating appendicitis, typhoid, tuberculosis and trauma. According to Ghosh et al. (2016) the gastro-duodenal perforation was still the most common cause of perforation peritonitis in India. In north-eastern Nigeria typhoid ileal perforation was the most common cause of perforation peritonitis (Ali & Gali, 2010). The pattern of perforation peritonitis at UTH in Zambia has not been described in the local literature.

2.10 Category of Surgeon

Consultant surgeons oversee the activities of the surgical units in the Surgery Department and inculcate surgical principles in the unit members for continuity of surgical care. At the UTH, Surgery Department, the emergency theatres are manned by registrars and senior house officers, and more than 50% of emergency surgeries are performed by registrars (Nthele & Odimba, 2006). Besides consultants, senior registrars lead the operations. Watt, Wilson, Shapter, and Patil (2015) suggested that for emergency laparotomy where *mortality* is

expected to be high, a consultant surgeon and consultant anaesthetist should be present in the theatre. In addition, as the consultants' involvement during emergency laparotomy increases, the 30 day *mortality* rate decreases (Saunders et al., 2012). Consultant-led management of surgical patient help maintain the principles of continuity of surgical care (Saunders et al., 2012).

The practice of surgery requires acquiring technical skills and procedural competence from many different observed and performed cases. In order to gain the experience the registrars spend a substantial part of their time operating in theatre (Pape & Pfeifer, 2009). Experience of the operating surgeon has a bearing on the surgical outcome; surgical experience or high case load is associated with reduced rate of complication and errors (Pape & Pfeifer, 2009). However, assessing technical skills, procedure competence and the degree of surgical experience is difficult. As a result, analyses of surgical adverse events, *mortality*, and morbidity is used to assess operative skills indirectly (Pape & Pfeifer, 2009).

The quality of training of the surgeons has influence on the optimal management of surgical patients (Di Saverio et al., 2015). Lack of adequate input from the senior surgeons can hamper surgical patient management (Saunders et al., 2012). Furthermore, lack of surgical competence among the operating general surgeon poses a safety risk to surgical patients (Di Saverio et al., 2015). Competence of the surgeon beside the surgical approach, and technique can influence the outcome of laparotomy. However for the purposes of the study and to limit the category of surgeon acting as a confounding factor; data collection in all patients and the bulk of the operations were conducted by one surgeon either as assistant or operator.

2.11 A Review by Region

In the United Kingdom (UK), it was noted that when compared to elective surgery, emergency surgery was associated with poorer outcomes and higher *mortality* (Watt et al.,

2015). The 30-day *mortality* was 12%. Similar studies in the USA found it to be 14-15%. Watt et al. (2015) bemoaned the little emphasis placed on improving outcomes and management of patients who undergo an emergency laparotomy compared to elective laparotomy in surgery. It was noted that emergency laparotomies demanded a lot of hospital resources, theatre time, theatre staff, senior surgeons and anaesthetists, radiology input and longer hospital stays (Watt et al., 2015).

In Delhi, India, Yadav and Garg (2013) found that advanced age, late presentation, delay in the treatment, septicaemia, and associated co-morbidity contributed to the high *mortality* and postoperative complications.

In semi urban regions of Africa, Adesunkanmi et al. (2003) found that age of the patient, cause of intestinal perforation, and amount of pus drained during operation independently predict the postoperative morbidity and *mortality* rates (Table 2.2). In north eastern Nigeria the outcome of perforation peritonitis was found to be influenced by the underlying cause, duration of symptoms, and patient's general health (Ali & Gali, 2010). The most common cause of perforation peritonitis was typhoid followed by perforated peptic ulcer, and perforated appendix. The others were gallbladder perforation, perforated colon cancer, and lastly tuberculous ileal perforation. The overall *mortality* rate was 26.1%, with the most common short-term postoperative complication being wound infection followed by *wound dehiscence*, and enterocutaneous fistula (Ali & Gali, 2010).

In Lilongwe, Malawi, the most common causes of peritonitis were appendicitis, intestinal volvulus, perforated peptic ulcer and small bowel perforation in that order (Samuel et al., 2011).

Table 2. 2: Summary of the reviewed literature

AUTHORS	DESIGN	FINDINGS	REGION
Doklestić et al. (2014)	Retrospective study of patients with secondary peritonitis	Acid peptic disease was the most common cause of perforation peritonitis followed by perforated appendicitis. ***Mortality* rate 8.82%.**	Serbia
Notash et al. (2005)	Prospective evaluation of the MPI and MOF score in patients with peritonitis	The MPI and MOF scores provide simple and objective means to predict the outcome of patients with peritonitis	Iran
Mulari & Leppäniemi, (2004)	Retrospective analysis of patients with secondary peritonitis caused by gastrointestinal tract perforation	Age, pre-existing illness, chronic medication, type of peritonitis, MPI score, CRP levels have prognostic significance	Helsinki, Finland
Watt et al. (2015)	Retrospective study of patients who underwent emergency laparotomy	Emergency laparotomy carries a high rate of *mortality*. **30-day *mortality* was 12%.**	United Kingdom (UK)
Gauzit et al. (2009)	Prospective, observational study of patients with secondary Peritonitis	Peritonitis arising from the colon was commonest followed by appendix. The presence of Enterococcus spp. in peritoneal cultures increased morbidity but not the *mortality* rate. **The overall *mortality* rate 15%**	France
Singh et al. (1998)	A prospective study conducted on patients with non-traumatic intestinal perforation and peritonitis	Immediate postoperative feeding is feasible and reduces septic morbidity. Complications: wound infection, *dehiscence, leak, re-laparotomy*, respiratory failure, intra-abdominal abscess. **Overall *mortality* rate of 18.6%**.	India

AUTHORS	DESIGN	FINDINGS	REGION
Yadav & Garg (2013)	Prospective study of perforation peritonitis	Spectrum of perforation peritonitis continues to differ from western countries. Major complications: wound infection and *wound dehiscence* with **13% *mortality***	Delhi, India
Ghosh et al. (2016)	Prospective, longitudinal, observational study of secondary peritonitis	Gastro-duodenal perforation was the most common cause of secondary peritonitis contrary to appendicular perforation. Wound infection was the most common complication. **The overall *mortality* was 8.4%**	India
Bali et al. (2014)	Retrospective study Perforation Peritonitis and the Developing World	The etiological spectrum of perforation peritonitis differs significantly from its western counter parts. The commonest is peptic ulcer disease followed by appendicitis, typhoid fever, tuberculosis, and trauma. ***Mortality* rate 7%.**	India
Adesunkanmi, Badmus, & Ogundoyin, (2003)	Prospective study of the causes and determinants of outcome of intestinal perforations in a semi urban African community	Factors such as age, cause of intestinal perforation, and amount of pus drained during operation independently predicts the postoperative morbidity and *mortality* rates.	Nigeria
Ali & Gali, (2010)	Retrospective study of patients with intra-operative diagnosis of non-traumatic perforation associated peritonitis	Aetiology, duration of symptoms, and patient's general health influenced outcome. Post-operative complications: wound infection, enterocutaneous fistula and *wound dehiscence* in that order. **Overall *mortality* rate 26.1%**	North eastern, Nigeria

AUTHORS	DESIGN	FINDINGS	REGION
Samuel et al. (2011)	Observational Study of the Aetiology, clinical presentation and outcomes associated with peritonitis	Appendicitis was the most common cause of peritonitis, and the overall ***mortality*** rate among all patients with peritonitis was **15%**	Lilongwe, Malawi
Nthele & Odimba, (2006)	Prospective study of re-laparotomies at UTH	20 % of all abdominal surgeries were due to perforation peritonitis. **40% *mortality* rate on** *re-laparotomies,* and it was not possible to attribute the *leaks* to the level of competence of surgeons	Lusaka, Zambia
Phiri, & Odimba, (2007)	A prospective descriptive cross section study of perforated acute appendicitis at the UTH	Perforated appendicitis has 1.4% overall *mortality* rate. Only wound infection (33.3%) and *re-laparotomy* (22.2%) were studied	Lusaka, Zambia
Sondashi et al.(2011)	Cross-section study on factors **associated with perforated peptic ulcer** disease presenting to the UTH	Male preponderance. ***Mortality* rate 37%** for peritonitis due to peptic ulcer disease. No *wound dehiscence, leakage and re-laparotomy* were studied	Lusaka, Zambia

In Zambia at UTH, the *mortality* rate for peritonitis due to gastric perforation was as high as 37% (Sondashi et al., 2011). At the UTH85% of laparotomies were done as emergency cases, and about 20 % of all abdominal surgeries were due to perforation peritonitis (Nthele & Odimba, 2006). Most patients undergoing emergency laparotomy for perforation peritonitis are men. In India, the majority of patients with perforation peritonitis are male with male to female ratio 2.1:1 (Bali et al., 2014). In a study conducted at UTH by Nthele and Odimba (2006) men underwent laparotomies more than women with the male to female ratio of 3:1. However, the ratio for those having emergency laparotomies for perforation peritonitis in Zambia is not well known or documented. Phiri and Odimba (2007) found that perforated acute appendicitis was associated with high levels of morbidity. The short term outcomes reported were wound infection 33.3%, *re-laparotomy* 22.2%, and the overall *mortality* rate of 1.4 % (Phiri & Odimba, 2007). Although *mortality* rate for gastro-duodenal perforation

peritonitis is known, no UTH references are available for *leakage*, *wound dehiscence*, and *re-laparotomy* at first admission for gastro-duodenal perforation peritonitis. Furthermore, the outcome of perforation peritonitis due to jejunal, ileal and colonic perforation including the role of scoring systems in the development of these outcomes have not been established. Hence the need to undertake this study.

CHAPTER 3 : METHODOLOGY

3.1 Methodology

The study was prospective observational study conducted at the Department of Surgery of the University Teaching Hospitals, Lusaka from July 2018 to March, 2019. Patients with peritonitis admitted to the surgical department were screened. One hundred adult patients with spontaneous perforation peritonitis met the inclusion criteria and were recruited. After clinical assessment and adequate resuscitation with administration of intravenous fluids, antibiotics, placement of nasogastric tube, and scoring using POSSUM for general surgery, patients were taken to Phase 5 emergency theatre for exploratory laparotomy under general anaesthesia.

3.2 Criteria

3.2.1 Inclusion criteria

All adult patients 18 years or above with a preoperative or intraoperative diagnosis of perforation peritonitis and had given pre or post-operative informed consent were included.

3.2.2 Exclusion criteria

Patients undergoing emergency exploratory laparotomy due to traumatic bowel or gastric laceration, perforated appendix, and oesophageal perforation

3.3 Procedure

Patients admitted in the surgical ward or operated on with a diagnosis of perforation peritonitis were included in the study by the researcher. All patients gave informed consent, and where the patient was unable to consent, relatives gave consent. All the recruited patients were scored using the POSSUM system for general surgery either on admission or intra-

operatively. The expected *mortality* and morbidity rate for each patient was calculated. The exploratory laparotomy was performed in the emergency theatre. Operative findings were recorded and the type of surgical procedure was decided upon based on intra-operative findings. Lavage with warm saline was performed. In the postoperative management, the decision to transfer the patient to the common surgical ward or intensive care unit was made by the operating surgeon and anaesthetist. Patients were followed up daily in the surgical ward and ICU until discharge while capturing information on outcome relevant to the study.

For malignant perforation, the standard operative and post-operative management applied. Non-malignant gastric perforations had the edges freshened and repaired in two layers with omental patch. Small bowel perforations were managed mainly by freshening the edges and repair, resection of unhealthy portion plus end-to-end anastomosis, right hemi-colectomy plus ileo-transverse colon anastomosis, and lastly ileostomy. Colonic perforations were managed by colectomy plus primary end to end anastomosis in two layers, or colectomy plus colostomy.

Peritoneal lavage was done using warm normal saline and tube drains were placed where indicated. The rectus sheath was closed by continuous non-absorbable suture, and the skin approximated with interrupted non-absorbable sutures. All patients received postoperative intravenous antibiotic therapy with ceftriaxone plus metronidazole while in the ward until discharge and orally following discharge. For gastric perforation the proton pump inhibitor (PPI) rabeprazole was administered intravenously and orally as indicated. The outcome assessed by clinical observation within 30 days were prospectively captured by the researcher. All patients were reviewed daily until discharge, and in the surgical clinic within 30 days. For those that developed complications appropriate measures were undertaken to manage them.

3.4 Study outcomes

The primary outcome during the study was in-hospital *mortality*, and the secondary outcomes were *leakage*, *wound dehiscence*, and *re-laparotomy*.

3.5 Data

The age; gender; residence; employment status; level of education; indications for surgery; intra-operative findings; *site* of perforation; procedure done; POSSUM score; and post-operative outcome were collected by the researcher using data collection tools and entered in excel spreadsheet (Table 3.1).

Table 3. 1: Data type and variables

Variable type	Variables	Data type
Independent **variables**	Age	Continuous data
	Gender	Categorical(nominal) data
	Employment status	Categorical data
	Level of education	Categorical data
	Indication/Diagnosis	Categorical
	Operative findings	Categorical
	Site of perforation	Ordinal data
	Procedure done	Categorical
	POSSUM score	Continuous data
Dependent **variables**	*Mortality*	Categorical data
	Wound dehiscence	
	Leak	
	Re-laparotomy	

3.6 Statistical Analysis

Statistical analysis was performed using SPSS version 20.0. Statistical significance was defined by $p<0.05$ and 95% confidence interval. Continuous data presented as mean± standard deviation (SD), range, median, and mode. Categorical data reported as proportions and tested for significance using Chi-square. Outcome (dead/alive or complicated/uncomplicated) as dependent variables were compared between predicted and observed rates of morbidity and *mortality*, and significance determined using chi-square test. The predictor variables were correlated to demonstrate the relationship. For binary outcome (dead/alive, *wound dehiscence/* no *wound dehiscence*, *leak*/no *leak* and *re-laparotomy*/no *re-laparotomy*) logistic regression analysis was used.

The physiological variables were captured at the time of surgery and include clinical symptoms and signs, biochemical and haematological investigations and electrocardiogram (ECG). When the variable was not available, a score of one was given. The minimum POSSUM score had 12 as a minimum score and 88 as a maximum score. Once the score was known the predicted risk for *mortality* and morbidity were estimated using the following equations.

POSSUM equation for morbidity:

Logn R/ (1-R) = -5.91 + (0.16 × physiological score) + (.19 × operative severity score)

POSSUM equation for *mortality*:

Logn R/ (1-R) = -7.04 + (.13 × physiological score) + (.16 × operative severity score)
Where R = predicted risk

The categories of risk of *mortality* were

0-10%

>10-20%

>20-30%

>30-40%

>40-50%

>50%

The categories of risk of morbidity were

0 to 20%

>20 to 40%

>40 to 60%

>60 to 80%

>80 to 100%

The patient's calculated risk values were place in the above intervals both for *mortality* and morbidity scored.

3.7 Limitations of the study

One of the physiological scores on the POSSUM score for general surgery was an ECG. In the UTH where the study was performed, availability of an ECG machine and a technician to perform the test is limited to certain areas of the hospital and is not immediately available for patients admitted to the surgical wards where acute abdomens are managed. Thus ECG evaluation was not included in our patients' data capture. The ECGs were only done on consultation during the day in a different department from surgery. The recruited patients come at different times of the day and were managed as emergencies making access to ECG facilities logistically not possible. Only one patient had ECG done as he was already being managed by the physician in the internal medicine ward before developing perforation peritonitis. Even though this was a definite limitation of the study the results can be extrapolated to most hospitals in the country where emergency access to ECG machines and

technicians is restricted thus more weighing can be attributed to the other parameters which all hospitals have readily available

Lastly, the researcher participated in sixty six laparotomies of which he performed forty six and assisted in twenty emergency laparotomies. Thirty four were not performed by the researcher. The inability by the researcher to perform all the laparotomies during the study could have brought in confounding factors. Joining the surgical team on call during the night posed a logistical challenge for the researcher who was expected to participate in all the emergency laparotomies for recruited patients. However, data collection was standard and complete in all the laparotomies irrespective of the operator.

Late presentation due to distance, lack of funds or transport could have influenced the results of this study and POSSUM score.

3.8 Ethical Issues

3.8.1 Written Informed consent

Besides the operation consent, all patients were required to consent to be a participant in the study. For critically ill patients who are unable to give consent, the informed consent was obtained from a legally authorized surrogate or legal next of kin. Once the patient was in a state to give informed consent, it was obtained from them immediately. There was no undue influence or coercion during the informed consent process, and the consent process lasted from initial information to end of the study (Code, 1949; DeRenzo & Moss, 2006).

3.8.2 Voluntary participation

Patients participated in the study voluntarily in accordance with the Helsinki Declaration and could withdraw from the study without compromising the standard treatment for the condition (World Medical Association, 2001).

3.8.3 Recruitment of participants

The researcher was responsible for recruiting participants (DeRenzo & Moss, 2006). Recruitment of participants started once the study was approved by ERES Converge Institutional Review Board. Participants were recruited in the study preoperatively in the surgical ward or intra-operatively in operating theatre upon confirming the diagnosis of perforation peritonitis. The participants were given a printed copy of the participant information sheet as additional information about the study.

3.8.4 Confidentiality

The researcher had the responsibility to guard and respect the confidential nature of participant information during the study (DeRenzo & Moss, 2006). The privacy and dignity of the participants was protected. The responsibility for the participants rested with the researcher, and participants were identified using study participant number. All records were managed and stored under lock and key in the researcher's safe locker in the registrars' room in the Surgery Department at the UTH. The researcher didn't divulge information without permission.

3.8.5 Risks and Benefits

Risks associated with the surgery are such as what would be expected in operations of this nature. Research procedures conducted during the perioperative period were part of standard clinical care. In the management of the patient the standard care offered was not affected by patient's participation or withdrawal. Altruistic reward was the value of participation (DeRenzo & Moss, 2006). There was no monetary benefit for participants.

3.8.6 Study Approval and Permission

The research study was approved by ERES Converge Institution Review Board, and permission was granted for the study to be conducted by the UTH administration.

3.8.7 Data collection and Management

Data collection tool was used to collect data that was captured on *site* and kept both electronically, and on traditional paper. Data entry was explained to the research *site* team members, and appropriate and accurate record keeping emphasized. The principal investigator collected and managed the data, and ensured that the participants' information was secure (DeRenzo & Moss, 2006).

CHAPTER 4 : RESULTS

4.1 Laparotomies at UTH

During the study period of nine months from July, 2018 to March 2019, there were about 415 laparotomies done in phase five emergency theatre for various indications. About 125 (30.1%) laparotomies were performed for non-traumatic perforation peritonitis and 100 met the inclusion criteria (Figure 4.1). About thirty emergency laparotomies were done due to perforation peritonitis

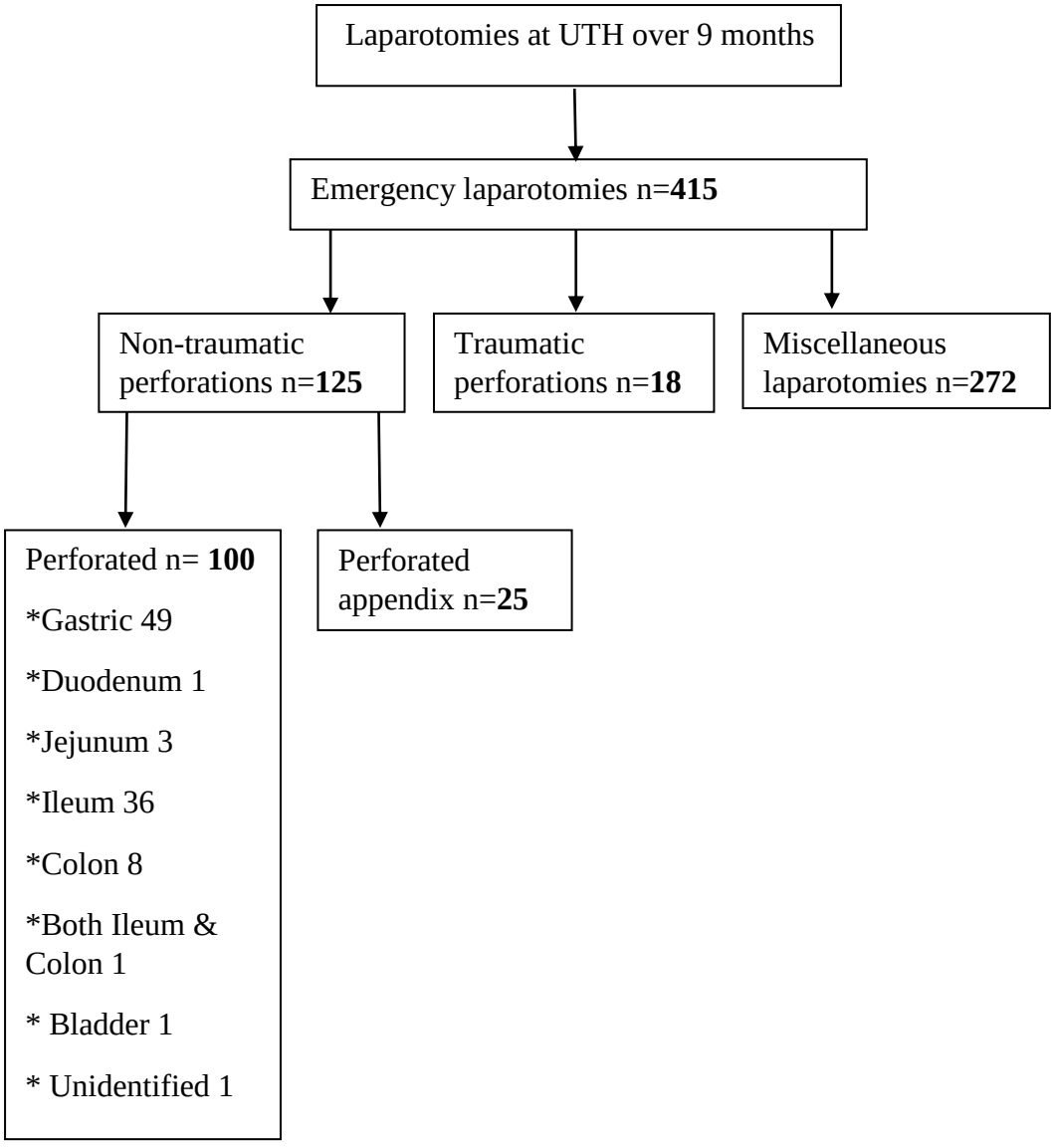


Figure 4. 1: Flow diagram of laparotomies and study inclusion

4.2 Demography

4.2.1 Gender, Age and Level of education

The study included 100 patients with a mean age of 37.24±14.12 SD (range 18 to 78 years). There were 77 males and 23 females giving a 3.34:1 ratio (Table 4.1).

Table 4. 1: Summary of the findings

Item	**Description**
Age	37.24±14.12 (range 18 to 78 years)
Gender	77 males : 23 females
Residence	
Lusaka Resident	77
Outside Lusaka	23
Level of Education	
Primary	32
Secondary	47
Tertiary	19
None	2
***Site* of perforation**	
Gastric	49
Duodenum	1
Jejunum	3
Ileum	36
Both ileum & colon	1
Colon	8
Others: unidentified &urinary bladder	2
Hospital stay in days	9.53±6.86 (Range 0 to 30 days)
POSSUM Score	45.68±8.98 (Range 28 to 68)

The median age was 34 years and the mode 32 years. Fifty five patients were not in employment and 45 were employed. In terms of level of education, 47 had secondary education, 32 with primary, 19 with tertiary education, and two patients had no classroom-based education (Figure 4.2).

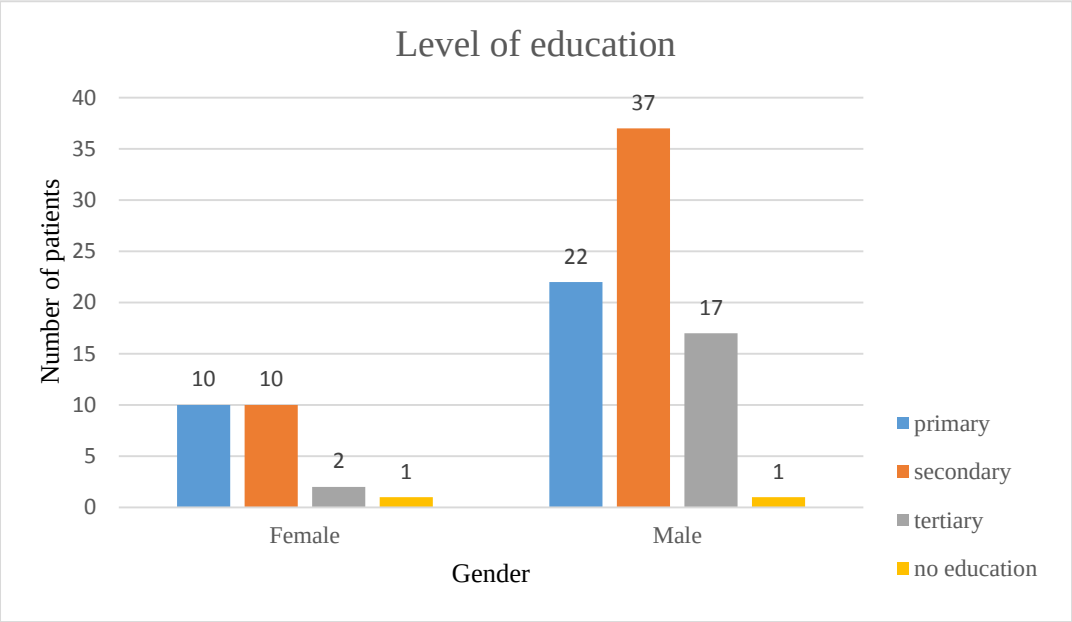


Figure 4. 2: Histogram showing level of education and gender of the participants

4.2.2 Residence

Seventy seven cases of perforation came from Lusaka while 23 from outside Lusaka (Table 4.2). Six patients from Chibombo, five patients from Mumbwa, three patients from Chilanga, two patients from Kafue as well as two from Chikankata, one each from Mazabuka, Siavonga, Kabwe, Luanshya and Chongwe (Figure 4.3). Lusaka recorded 37 gastric perforations, 26 ileal perforations, seven colonic perforation, three jejunal perforations, one duodenal perforation, one involving both ileal and colon, one urinary bladder perforation and one unidentified *site* in a patient with clinical and intraoperative features of perforation

peritonitis. The perforations from outside Lusaka city were 12 gastric perforations and 10 ileal perforations and one colonic perforation.

Table 4. 2: The *site* of perforation and the regions of the country where patients came from.

TOWN /CITY	PERFORATION *SITE*							
	Gastric	Duodenum	Jejunum	Ileum	Colon	Both ileum & caecum	Others	Number of patients
Lusaka	37	1	3	26	7	1	2	77
Chilanga	2			1				3
Kafue	2							2
Chikankata	2							2
Mazabuka	1							1
Siavonga	1							1
Mumbwa	2			2	1			5
Chibombo	1			5				6
Kabwe				1				1
Luanshya	1							1
Chongwe				1				1
Total	**49**	**1**	**3**	**36**	**8**	**1**	**2**	**100**

Figure 4. 3: Towns and districts where perforation peritonitis patients reside.

Source: Map data ©2019 Google

Map scale 50 km

Key:

Regions where patients reside

UTH in Lusaka

The 77 perforations from Lusaka town came from 34 different residential areas and Kanyama had nine cases followed by Chawama seven cases, George had five cases as well as Garden house five perforation peritonitis cases (Figure 4.4). The followings locations Jack, John Howard, John Laing, Matero, Misisi and Mtendere had three perforation peritonitis each.

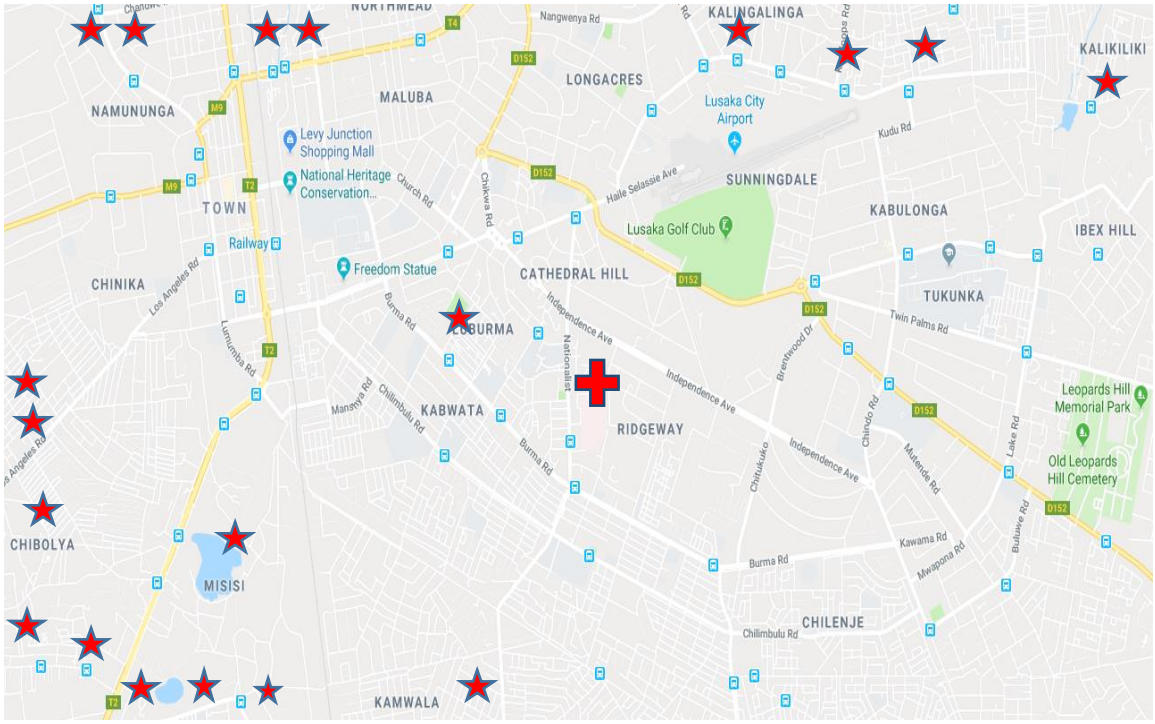


Figure 4. 4: Map of Lusaka showing selected residences of patients.

Source: Map data ©2019 Google

Map scale: 2000ft

Key:

Residence of patient

UTH

4.3 Preoperative and intraoperative diagnosis

4.3.1 Preoperative diagnosis

Thirty four patients had the diagnosis of perforation peritonitis due to viscus perforation as preoperative diagnosis, followed by 29 who had the preoperative diagnosis of peritonitis/ acute abdomen, 18 had diagnosis of intestinal obstruction due to query cause, nine patients presented with peritonitis with complications such hypovolemia, anaemia and/or acute kidney injury (AKI) and only seven had the preoperative diagnosis of peritonitis that was the same as the intraoperative diagnosis. For the last three cases, one had perforated bowel in a right

inguinal hernia, one had gastric outlet obstruction and one presented as acute appendicitis (Table 4.3).

Table 4. 3: Preoperative indications for surgery

INDICATION FOR SURGERY PREOPERATIVE DIAGNOSIS	GENDER Female	Male	Total
Peritonitis due viscus perforation	5	29	34
Peritonitis /Acute abdomen	9	20	29
Peritonitis with same OT diagnosis	3	4	7
Peritonitis with complications shock/anaemia/AKI	5	4	9
Intestinal obstruction	1	17	18
Hernia with perforation		1	1
Gastric outlet obstruction		1	1
Acute appendicitis		1	1
Grand Total	**23**	**77**	**100**

4.3.2 Intraoperative cause of peritonitis

There were 42 gastric perforations in males compared to seven in female and twenty six ileal perforations in males compared to ten in female patients (Table 4.4). All other perforations; duodenal, jejunal, and urinary bladder were in males except for colonic perforations which were less in males (3) compared to females (5). Chi square test gave p=0.0498.

Table 4. 4: Intraoperative cause of peritonitis and gender

Intraoperative Cause Of Perforation Peritonitis	Gender		
	Female	**Male**	**Total**
Gastric	7	42	49
Duodenal		1	1
Jejunal		3	3
Ileal	10	26	36
Colon	5	3	8
Both Ileum & Colon	1		1
Others (Urinary Bladder, Unidentified)		2	2
Grand Total	23	77	100

Intra-operatively, the cause of perforation peritonitis were gastric perforation forty nine (49%) then peritonitis secondary to ileal perforation thirty six (36%) and colonic perforation eight (8%). Peritonitis due to perforation of the jejunum were three (3%), duodenal one (1%), both ileum and colon one (1%), urinary bladder one (1%), and unidentified *site* one (1%) (Table 4.5).

Table 4. 5: The causes of perforation peritonitis

Causes of Perforation Peritonitis	Number of patients
Gastric perforation	49
Ileal perforation	36
Colon perforation	8
Jejunal perforation	3
Duodenal perforation	1
Both ileal & colon perforation	1
Urinary bladder perforation	1
Unidentified perforation	1
Grand Total	100

4.4 Operative procedure

There were 49 gastric perforations recorded and in 48, the procedure was freshening of edges, and repair with an omental patch; while in one patient who had the largest perforation (10cm x10cm) involving the anterior and posterior walls, partial gastrectomy and gastro-jejunostomy was done (Table 4.6).

For small bowel perforation, 26 patients had bowel freshening of edges and repair of the perforation. Ten patients had ileal resection and ileostomy without anastomosis, and three had ileal resection plus end to end primary anastomosis performed. Right hemi-colectomy plus ileo-transverse colon anastomosis was performed in four patients for terminal ileal as well as caecal and ascending colon perforation. Colectomy plus stoma creation was conducted in two patients with colonic perforations while one had sigmoidectomy and primary end to end

anastomosis for sigmoid tumour perforation. Two colonic perforations had edges freshened and repaired. Patient who had multiple ileal and caecal perforations had ileostomy and caecostomy done.

Table 4. 6: The summary of procedures done for perforation peritonitis

PROCEDURE DONE	COUNT (n=100)
Gastric	
Gastric freshening of edges, repair plus omental patch	48
Partial gastrectomy plus gastro-jejunostomy	1
Small Bowel	
Duodenal freshening of edges plus repair	1
Jejunal freshening of edges plus repair	3
Ileal freshening of edges plus repair	22
Ileostomy, loop	10
Ileal resection and primary end to end anastomosis	3
Right hemi-colectomy plus primary anastomosis	4
Large bowel	
Colectomy plus colostomy	2
Colectomy plus primary end to end anastomosis	1
Colostomy	1
Colon freshening of edges plus repair	2
Others	
Urinary bladder freshening of edges plus repair	1
Adhesiolysis plus lavage (unidentified *site*)	1

4.5 *Site* of perforation

4.5.1 *Site* of perforation by count and number of perforation

The stomach had 49 perforations and 41 were anterior on the pyloric antrum. Gastric perforations accounted for 49% of all perforations. Seven gastric perforations were found on the body of the stomach (Table 4.7).

There were 36 ileal perforations and only one patient both ileal and caecal perforations. For the large bowel 8 perforations were recorded; four on the sigmoid colon, two on the transverse colon, one had caecal perforation, and one patient had both caecal and ascending colon perforations. There was one urinary bladder perforation and one perforation which was not identified at the time of surgery even though the patient had clinical and intraoperative features of perforation peritonitis.

Table 4. 7: The anatomic *site* of perforation

Site of Perforation	Number of patients
Gastric: pyloric antrum anterior	41
Gastric: Body anterior	7
Gastric: both anterior &posterior	1
Duodenum	1
Jejunum	3
Ileum	36
Both ileum& caecum	1
Colon (Caecum, ascending, transverse, sigmoid)	8
Others: unidentified & Urinary bladder	2
Total	**100**

Eighty eight out of 100 cases had single perforation with seven patients having two perforations. Out of seven cases with double perforations five were from the ileum, stomach and caecum and ascending colon. Five patients had more than three perforations found intra-operatively (Table 4.8).

Table 4. 8: The number of perforation and anatomical *site*

	Number of perforations			
Site of Perforation	1	2	3	Grand Total
Gastric :anterior pyloric antrum	40	1		41
Gastric: body	7			7
Gastric: both posterior & anterior	1			1
Duodenum	1			1
Jejunum	3			3
Ileum	27	5	4	36
Both ileum & cecum			1	1
Colon (caecum, ascending, transverse, sigmoid)	7	1		8
Others: sealed *site* &urinary bladder	2			2
Grand Total	**88**	**7**	**5**	**100**

4.5.2 *Site* of perforation by size of perforation

The estimated size of the perforations ranged from less than a centimetre to about 10cm. Seventy one percent of perforations were 1cm or less in size, seventeen were2cm in size followed by seven with 3cm perforations (Figure 4.5). Only two perforations had the size more than 5cm in length, gastric and caecum. The largest sized perforation was a gastric perforation estimated at 10 x 10cm. Thirty five of the 1cm or less sized perforations were from the stomach while 27 from the ileum (Table 4. 9).

Table 4. 9: The count of size of perforation in relation to the *site* of the perforation

	SIZE OF PERFORATION						
***SITE* OF PERFORATION**	**1cm & less**	**2cm**	**3cm**	**4cm**	**5cm & above**	**Others: not identified**	**Total**
Gastric antrum	31	8	2				41
Gastric: body	4	1		2			7
Gastric: anterior &posterior					1		1
Duodenum				1			1
Jejunum	3						3
Ileum	27	5	4				36
Ileum& caecum			1				1
Colon (caecum, ascending, transverse, sigmoid)	5	1		1	1		8
Others	1					1	2
Grand Total	**71**	**15**	**7**	**4**	**2**	**1**	**100**

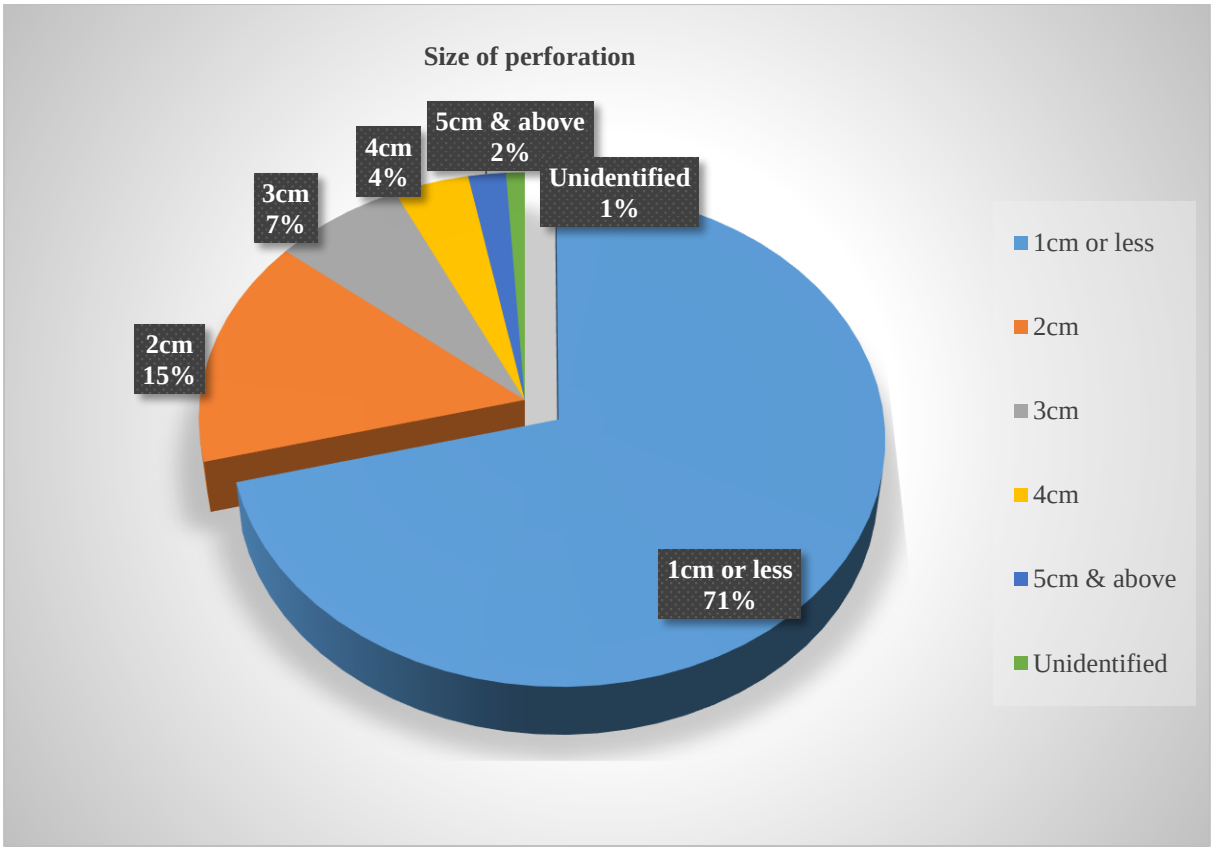


Figure 4. 5: The size of perforation

4.6 *Site* of perforation and Outcome

4.6.1 *Site* of perforation and *leak*

Nine patients had GIT *leak* in the 30-day postoperative period (Table 4.10). Five *leaks* were post gastric repair, two followed ileum repair and another after colon perforation repair. The partial gastrectomy as well as the four pyloric antrum gastric perforations that were repaired broke down in the postoperative period. Generally the *site* of perforation was significantly related to the outcome of *leak* (Chi-square value=23.95, p=0.021)

Table 4. 10: *Leak* in relation to *site* of perforation

Site of Perforation	*Leak* (n)
Gastric: pyloric antrum anterior	4
Gastric: Both anterior &posterior	1
Ileum	2
Colon (Caecum, sigmoid))	2
Grand Total	**9**

4.6.2 *Site* of perforation and *wound dehiscence*

Three (3%) patients with perforation developed abdominal *wound dehiscence*. Two patients had ileal perforation peritonitis while the other had perforation on the body of the stomach (Table 4.11). The *site* of perforation was not significantly related to *wound dehiscence* (Chi-square=6.14, p=0.899)

Table 4. 11: Abdominal *wound dehiscence* in relation to perforation *site*

Site of perforation	*Wound dehiscence* (n)
Gastric: body	1
Ileum	2
Grand Total	**3**

4.6.3 *Site* of perforation and *re-laparotomy*

There were 10 re-laparotomies for gastric perforations, eight were for anterior pyloric antrum while two were for gastric perforations from the body of the stomach. Six re-laparotomies were done for ileal perforations and one for colon perforation (Table 4.12). Chi-square value 3.52, p=0.991.

Table 4. 12: Anatomical *site* of perforation in relation to *re-laparotomy*

***Site* of Perforation**	**Re-laparotomy (n)**
Gastric: pyloric antrum anterior	8
Gastric: body	2
Ileum	6
Colon (Sigmoid)	1
Grand Total	**17**

4.6.4 *Site* of perforation and *Mortality*

Out of the 36 perforation peritonitis deaths, 16 had gastric perforations mostly from the pyloric antrum anteriorly, 12 had ileal perforations and three had colonic perforation (Table 4.13). Almost seventy percent (67.8%) of variance in the *mortality* outcome was predicted by *site* of perforation, number of perforations, patient's physiological and operative score. The *site* of perforation alone showed no relationship with the outcome of *mortality* (Chi-square value 15.73, p=0.204).

Table 4. 13: Death according to the *site* of perforation

***Site* of perforation**	**Outcome of *mortality***
Gastric: pyloric antrum anterior	13
Gastric: body	2
Gastric: both anterior and posterior	1
Duodenum	1
Jejunum	1
Ileum	12
Both ileum & Cecum	1
Colon(caecum)	1
Colon (caecum& Ascending)	1
Colon (Transverse)	1
Others: unidentified & urinary bladder	2
Total	**36**

The outcome of *leak, wound dehiscence, re-laparotomy, mortality,* and survivors in relation to the *site* of perforation were summarised in table 4.14.

Table 4. 14: Summary of outcomes in relation to *site* of perforation

OUTCOME	***SITE* OF PERFORATION (Number, %)**					
	Stomach	**Duodenum**	**Jejunum**	**Ileum**	**Colon**	**Others**
Leak	5(10.20)	-	-	2(5.55)	2(25)	-
Wound Dehiscence	1(2.04)	-	-	2(5.55)	-	-
Re-laparotomy	10(20.41)	-	-	6(16.67)	1(12.5)	-
Mortality	16(32.65)	1(100)	1(33.33)	12(33.33)	3(37.5)	3(100)
Alive	33(67.35)	-	2(66.67)	24(66.67)	5(62.5)	-
TOTAL	**49**	**1**	**3**	**36**	**8**	**3**

4.6.5 Readmission during the study

Four patients out of the 64 patients that completed the study were re-admitted for various indications (Table 4.15). The reasons for readmission were ileostomy reversal post ileostomy, surgical *site* infection, intestinal obstruction and intra-abdominal fluid/pus collection.

Table 4. 15: Reasons for readmission

Reason for readmission	**Number (N)**
Ileostomy reversal post ileostomy	1
Surgical *site* infection	1
Intestinal obstruction due to small bowel volvulus and adhesions	1
Intra-abdominal fluid/pus collection	1
Total	4

4.6.6 Hospital stay

Hospital length of stay ranged from three hours to 30 days with the mean of 9.53±6.86 days. The median being 8 days and the mode of 6 days.

4.6.7 Admission to ICU

Thirty four (34%) participants required ICU care and the mean duration of stay in our intensive care unit was 3.39 ± 2.74 days with the range from 0.125 to 10 days. Median of 2.5 days. The most number of days spent by perforation peritonitis patients in our ICU was two days.

4.7 Postoperative outcomes

Thirty six (36%) patients with perforation peritonitis died, and 17 (17%) patients had second laparotomy, nine (9%) *leaked*, and three (3%) had abdominal *wound dehiscence*. Sixty four patients completed the study (Table 4.16). The morbidity rate was 17.19%. Eleven out 64 perforation peritonitis patients that survived were categorised as outcomes during the 30-day study period.

Table 4. 16: Post-operative outcome of perforation peritonitis

Postoperative Outcomes	**Number of patients(Percentage)**	**Chi-square**	**pValue**
Leak	9 (9%)	1.256	0.740
Wound dehiscence	3 (3%	1.806	0.614
Re-laparotomy	17 (17%)	3.384	0.344
Died	36 (36%)	16.11	0.007
Alive	64 (64%)		
TOTAL	**100**		

4.7.1 *Leak*

There were nine post-operative *leakages* recorded (Table 4.16) and the mean day of *leak* was 5.33 ±1.87. *Leak* days ranged from 3 to 8 days. The median as well as mode was 5 days. Pearson Chi-square value of 1.256 and p=0.740

4.7.2 *Wound dehiscence*

Three (3%) had abdominal fascial *wound dehiscence* (Table 4.16) and were taken back to theatre for peritoneal lavage and wound closure. Pearson Chi-Square of 1.806 and p=0.614.

4.7.3 *Re-laparotomy*

The mean duration from the first laparotomy to second laparotomy was 9.94 ± 5.82 days with a range from 3 to 25 day. The median was 8 days with 5 days being the mode. There were17 re-laparotomies done during the study (Table 4.16). Six re-laparotomies were performed for gastrointestinal repair *leak*, three for sub-hepatic/sub-hepatic abscess, one for intra-abdominal pus collection, one for post-operative intestinal obstruction (intraoperative; paralytic ileus), one for generalized postoperative peritonitis, one for gangrenous ileostomy, one for intestinal obstruction due to small bowel volvulus and adhesions and three were for *wound dehiscence* (Table 4.17).The intestinal obstruction patient was taken to theatre for *re-laparotomy* to relieve the obstruction while the patient with the intra-abdominal pus collection had peritoneal lavage. Stoma revision was done for gangrenous ileostomy. Pearson Chi-square value 3.384 and p= 0.344.

Table 4. 17: Indications for *re-laparotomy*

Indications for *re-laparotomy*	**Number of patients**
Leak	6
Wound dehiscence	3
Subphrenic/Subhepatic/interloop absceses	3
Intra-abdominal pus collection	1
Generalized postoperative peritonitis	1
Gangrenous Stoma	1
Intestinal obstruction due small bowel volvulus and adhesions	1
Post-operative intestinal obstruction (intraoperative: paralytic ileus)	1
Total	**17**

4.7.4 In-hospital *mortality*

At the time of death some patients had more than one possible cause of death. Septic shock was documented as the cause of death in 19 patients, followed by sepsis in 10 patients, acute kidney injury in nine patients, pneumonia/respiratory failure in three patients, multiple organ failure (MOF) in two patients, septicaemia in one patient, and disseminated Intravascular coagulopathy (DIC) due to upper GIT bleeding in one patient (Table 4.18).

Table 4. 18: Cause of death in perforation peritonitis

Cause of death	**Number of patients**
Septic shock	19
Sepsis	10
Acute kidney injury/Renal failure	9
Pneumonia/ Respiratory failure	3
Multiple Organ Failure	2
Septicaemia	1
DIC due upper GIT bleeding	1

Thirty six out of 100 patients died following perforation peritonitis. Twenty nine patients died in our main intensive care unit while seven patients died in the ordinary surgical ward. Out of 34 patients that were admitted to ICU, 29 patients died giving (85.29%) as ICU *mortality* rate

for perforation peritonitis (Table 4.19). The outcome of *mortality* in ICU was statistically significant with p value of 0.001. The P-POSSUM *mortality* score significantly predicted the *mortality* (Chi-square =16.11, p=0.007)

Table 4. 19: Outcome of peritonitis and area of admission

Outcome	**Surgical ward**	**ICU**	**Total**	***p*Value**
Alive	59	5	64	o.oo1
Died	7	29	36	
Grand Total	66	34	100	

4.8 POSSUM Score

The mean preoperative physiological score was 26.68±8.535 and ranged from 13 to 49. The median score was 25 with 30 as the mode. For the operative score, 19 was the mean, mode and median score, and the score ranged from 10 to 29. For the total POSSUM score for General Surgery 45.68±8.98 was the mean and ranged from 28 to 68.

The observed and predicted *mortality* were as highlighted (Table 4.20). The model used was able to predict *mortality*, and 82% of the outcome of *mortality* was predicted by the logistic regression model. The higher the physiological score (p value 0.049) and the operative score (p value 0.036) the more likely an outcome of *mortality* in a patient with perforation peritonitis. Odds ratio of 1.475 and 1.951 for physiological score and operative score respectively. In summary, there was a statistically significant relationship between the stomach as the *site* of perforation and *leakage* (p=0.008) (Table 4.21).

Table 4. 20: Observed and expected *mortality*

		Alive		Died		Total
		Observed	Expected	Observed	Expected	
Step 1	1	10	10.000	0	.000	10
	2	10	10.000	0	.000	10
	3	10	9.852	0	.148	10
	4	10	8.796	0	1.204	10
	5	6	7.875	4	2.125	10
	6	7	6.268	2	2.732	9
	7	5	6.516	6	4.484	11
	8	5	3.780	5	6.220	10
	9	1	.914	9	9.086	10
	10	0	.000	10	10.000	10

Overall the *site* of stomach, small and large bowel perforation was significantly associated with the post-operative outcome for GIT *leak* (p=0.021) (Table 4.21). The *site* of stomach, small and large bowel perforation was not significantly related to the post-operative outcome for *wound dehiscence and re-laparotomy*. The POSSUM morbidity score was unable to predict the morbidity for stomach, small bowel and large bowel perforation whereas overall, the POSSUM *mortality* score was able to predict *mortality* in patients with perforation peritonitis ($p<0.05$).

Table 4. 21: Summary of the *site* of perforation, outcome and POSSUM score

SITE	N (Patients)	OUTCOME	N(Rate)	Chi-Square	p-Value (overall)
Gastric	49	*Leak*	5(10.20%)	9.604	0.008
		Wound Dehiscence	1(2.04%)	6.451	0.168
		Re-laparotomy	10(20.41%)	0.564	0.754
		Mortality	16(32.65%)	2.132	0.344
		POSSUM predicted *morbidity*	-	5.99	0.200
		P-POSSUM predicted *mortality*	-	18.82	0.043
Small Bowel	40	*Leak*	2(5%)	0.65	0.885
		Wound Dehiscence	2(5%)	0.65	0.885
		Re-laparotomy	6(15%)	0.81	0.846
		Mortality	14(35%)	2.16	0.540
		POSSUM predicted *morbidity*	-	4.67	0.862
		P-POSSUM predicted *mortality*	-	16.795	0.331
Colon	8	*Leak*	2(25%)	4.00	0.261
		Wound Dehiscence	0	-	-
		Re-laparotomy	1(12.5%)	1.143	0.767
		Mortality	3(37.5%)	5.867	0.118
		POSSUM predicted *morbidity*	-	5.800	0.446
		P-POSSUM predicted *mortality*	-	8.00	0.534
Unidentified, bladder, both caecum &Ileum	3	*Mortality*	3(100%)	-	-

ITEM	N (Patients)	OUTCOME	N(Rate)	Chi-Square	P-Value
Overall *Sites*	100	*Leak*	9(9%)	23.95	0.021
		Wound dehiscence	3 (3%)	6.14	0.899
		Re-laparotomy	17(17%)	3.52	0.991
		Mortality	36(36%)	15.73	0.204
	100	P-POSSUM predicted *mortality*	36(36%)	100.14	0.001
POSSUM predicted *morbidity*	100	*Leak*	9(9%)	1.26	0.740
		Wound Dehiscence	3 (3%)	1.81	0.614
		Re-laparotomy	17(17%)	3.33	0.344
Overall *morbidity* rate	64	*Morbidity*	11(17.19%)		
P-POSSUM predicted *mortality*	100	*Mortality*	36(36%)	16.11	0.007
Logistic regression		*Mortality*	82% predicted by model	-	-

CHAPTER 5 : DISCUSSION

5.1 Demography

The demographic data; age, gender, education and residence about patients presenting with perforation peritonitis was captured.

5.1.1 Gender

The majority of our patients were males 77% and gave the ratio of male to female 3.35:1. There were more males than females presenting at the hospital with perforation peritonitis in the present study.

A similar pattern of perforation peritonitis in males has been reported in various other studies. Wabwire and Saidi (2014) in a similar study in Nairobi, found the male to female ratio was 4:1. In a study conducted in Turkey, Das et al. (2014) found that most of the patients were male (73.5 %) similar to what was found in our study. Bali et al. (2014) in a similar study in India noted that the male patients still outstripped the female by 2.1: 1 ratio. The same results were echoed in Nigeria by Ayandipo et al. (2016). Another study in India, Batra, Batra, and Utaal (2016) found much higher ratio of 7.7:1; males outnumbering the females. Our study found similar results to what is documented by other authors that males outnumber the females. The findings of male dominance consolidate what the literature documents about perforation peritonitis being more in male patients.

5.1.2 Age

In this study the mean age was 37.24 with a range from 18 to 78 years. Wabwire and Saidi (2014) reported the mean age lower than ours at 32.17 years with a range from 13-59 years as they included patients below 18 years of age. In a similar study in adults by Ayandipo et al. (2016) the age range was 20 - 84 years although the mean was age was higher 48 ± 12 years

than what we found. In India, Batra et al. (2016) found that the maximum numbers of patients with gastrointestinal perforations were in the age group of 30-49 years (34.4%). Bali et al. (2014) studied a total of 400 patients and the mean age was 37.8 years with a range from 13 to 88 years. In Ibadan Nigeria Ayandipo et al. (2016) studied 302 patients and found the mean age to be 48+/- 12 years. Perforation peritonitis occurs in varying age group from as young as 13 years to 88 years of age although in our study we included only adults 18 years and above.

5.1.3 Education

Almost half of the patients had secondary level of education (47%) followed by primary level of education 32%. Two (2%) patients had no classroom-based education. Ayandipo et al. (2016) demonstrated that the majority of patients with perforation peritonitis had primary level of education. However our study showed that the majority of our patients had secondary level of education. The reason for this finding is unknown and should be subject to a further study.

5.1.4 Residence

Most of the patients came from Lusaka and its surrounding areas representing 77% of patients. The UTH is the tertiary hospital and the highest referral centre. However even though the referred cases could have been managed at other well established hospitals patients are often brought to the UTH for definitive treatment. Others came from central province of Zambia from Kabwe, Mumbwa and Chibombo facilities. Patients from southern province came from as far as Siavonga, Chikankata and Mazabuka. Such patients have to endure travelling long distances which delays timely surgery resulting in worse and unfavourable post-operative outcomes. There was no single geographic area that dominated in perforation peritonitis as there were 34 different residences where patients came from.

Within Lusaka, the majority of patients came from Kanyama followed by Chawama and George compounds which are low income areas. Such distribution could be the reason why patients seek medical treatment at public hospitals, whereas the well to do patients often go to private hospitals or abroad.

5.2 Preoperative and Intraoperative diagnosis

In this study patient had various clinical presentations that lead to different preoperative diagnoses. However, irrespective of a definitive diagnosis all patients required surgery. Not all patient with perforation peritonitis had a diagnosis of perforation peritonitis preoperatively. The majority of patients (79%) presented with peritonitis. One third of patients had peritonitis with suspicion of hollow organ perforation. Seven (7%) patients had the diagnosis of perforation due a specified perforation *site* just as it was found intra-operatively. In our study nine (9%) patients presented with complications of peritonitis preoperatively. However those outcomes were not the complications the study was looking for. They presented with shock, AKI and electrolyte imbalance. Eighteen (18%) out of 100 patients presented with acute intestinal obstruction and intra-operatively they had perforation peritonitis (Table 4. 3). Intra-operatively, the commonest cause was found to be peritonitis secondary to gastric perforation (49%) followed by peritonitis due to ileal perforation (36%); peritonitis due to colonic perforation (8%); peritonitis due to jejunal perforation (3%); peritonitis due to duodenal (1%) and urinary bladder perforation (1%) (Table 4.5).

According to Gauzit et al. (2009) most of the patients (78%) with perforation peritonitis presented with generalized peritonitis similar to our finding of 79%. Regarding patients presenting with complications, Ali and Gali (2010) and Bali et al. (2014) reported that late presentation to the hospital or increasing duration of peritonitis were associated with

complications. Their finding supported our study finding where nine (9%) patients developed complications of peritonitis preoperatively.

In India Bali et al. (2014) and Ghosh et al. (2016) found gastro-duodenal perforation as the most common cause of perforation peritonitis. The finding by Bali et al. (2014) and Ghosh et al. (2016) were similar to our finding at the UTH.

5.3 *Site* of Perforation

In our study the commonest *site* of perforation was gastric (49%) followed by ileum (36%), colon (8%), jejunum (3%), duodenum (1%) and urinary bladder (1%). In India, a study by Batra et al. (2016) found similar results where gastro-duodenal perforations were the commonest followed by small bowel perforations and colonic perforations. However, other authors from India found contrasting results. Ilahi et al. (2017) and Kumar et al. (2011) identified duodenum as the commonest *site* of perforation (almost 50 percent) followed by ileum and stomach. Furthermore, in Nairobi, Kenya a study by Wabwire and Saidi (2014) supported duodenum (22.9%) as being the commonest *site* of GIT perforation then ileum, colon and lastly stomach. In France, differing findings have been documented by Gauzit et al. (2009) showing colon as the commonest *site* of perforation. Gauzit et al. (2009) studied 841 patients and found that the colon was the commonest *site* of perforation (32%) followed by appendix (31%), gastro-duodenal (18%), small bowel (13%), or biliary tract (6%). A retrospective study in Lilongwe, Malawi by Samuel et al. (2011) found the appendix to be the leading *site* of perforation although failed to note which *site* was more common between gastro-duodenal and small bowel. Our study did not include appendix perforation although 25 cases were documented during the study period (Figure 4.1). Appendix was the commonest *site* of GIT perforation as found in Lilongwe, Malawi. Ayandipo et al. (2016) in Idaban, Nigeria found that appendix perforation accounted for 27.5 per cent in 302 patients that had

perforation peritonitis. However, the profile of *site* of perforation demonstrates geographic variability. There is no one leading *site* of GIT perforation documented in the literature and the variation can also be noted within Africa. Other uncommon *sites* such as the biliary tract have been documented in France and Nigeria but in our study a rare *site* of perforation was the urinary bladder.

In our study, intra-operatively one patients (1%) had malignant sigmoid bowel perforation and another patient had malignant gastric bowel perforation. In Kenya, Wabwire and Saidi (2014) reported a higher rate malignant bowel perforations (4.3%). The rate was double what we found. However, in our case biopsies were not performed routinely as the procedure was not an objective of the study but were performed if malignancy was suspected; the two patients who had malignant bowel perforation were biopsied and malignancy confirmed histologically.

Forecasting the *site* of perforation possess a challenge to clinicians and most of the *sites* of perforation during this study were only found intra-operatively. Only nine *sites* of perforation were forecasted preoperatively otherwise most of the diagnoses were of peritonitis without the actual *site* of perforation. Even radiological tests such chest x-ray (CXR) and computer tomography (CT) scan cannot predict the *site* of a bowel perforation in all cases, according to Zissin, Osadchy and Gayer (2009) CT scan can accurately predict the *site* of bowel perforation in 82 to 90 percent of cases. In our study patients had access to chest x-rays when perforation of hollow viscus was suspected and other patients had abdominal x-ray when intestinal obstruction was the initial preoperative diagnosis. None of our patients had access to CT scan to identify the *site* of perforation. The diagnosis of peritonitis was clinical and the diagnosis of perforation peritonitis was supported by radiological finding of free gas under the diaphragm or pneumoperitoneum; however, not all patients who presented with perforation peritonitis demonstrated pneumoperitoneum. According to Guillem (2002) and

Bansal et al. (2012) radiographs demonstrated air under the diaphragm in 90 % of perforation peritonitis whereas 10% had pneumoperitoneum without perforation of hollow viscus.

5.3.1 Gastric Perforation

5.3.1.1 Site

The stomach was the commonest *site* of GIT perforations in 49% of patients, and 83.67%of them were anterior on the pyloric antrum of the stomach. Only seven (14.29%) had the body of the stomach as perforation *site*. One gastric perforation involved both the anterior and posterior walls of the stomach, and 48 patients had a single gastric perforation. Our findings of prepyloric perforation *site* was supported by Lohsiriwat, Prapasrivorakul and Lohsiriwat (2009) who found that the most common *site* of gastric perforation was the prepyloric region (74%) even though in our study the rate of 83.67% was higher than 74% documented.

5.3.1.2 POSSUM Score

The P-POSSUM predicted *mortality* significantly forecasted the outcome of *mortality* in patients with gastric perforation peritonitis (Chi-square=18.82, p=0.043) whereas the POSSUM predicted morbidity score could not predict *leak, wound dehiscence* and *re-laparotomy* (Chi-square=5.99, p=0.200).

5.3.1.3 Size

Most of the sizes were estimated to be 1cm x 1cm or less in 35 patients (71.43%), in nine patients (18.36%) it was 2cm, in five patients (10.2%) it was equal to 3cm. The largest estimated size of perforation was about 10 x 10cm. Furthermore, the most common measured size of gastric perforation was 1cm by 1cm or less. A study by Ilahi et al. (2017) only reported on the size of duodenal perforation as being 0.5 x 0.5cm even though other perforations such as gastric, ileal, jejunal, caecal perforations were found. The results

demonstrated the possible different sizes of gastric perforation, and the size of the perforation potentially influencing the intraoperative surgical procedure.

5.3.1.4 Procedure

Almost all the gastric perforations had edges freshened and primarily repaired with an omental patch. One patient who had the largest perforation 10 x 10cm involving the anterior and posterior stomach walls had partial gastrectomy and gastro-jejunostomy performed. Other authors such as Lohsiriwat et al. (2009) and Ilahi et al. (2017) supported this approach for large ulcers, however, the common procedure done for gastric perforation was primary repair plus omental patch. The same procedure is also advocated for gastro-duodenal perforations. In the guidelines for management of intra-abdominal infections following perforations of <2cm, Sartelli, et al. (2017) recommended simple closure with or without an omental patch. The authors suggested that adding an omental patch does not offer additional benefits in terms of surgical outcome and simple gastric repair alone suffices.

5.3.1.5 Leak

Five (10.2%) out of 49 gastric perforation peritonitis patients *leaked.* Four patients had gastric repair for anterior pyloric antrum perforation and one was post gastrectomy. The *site* of perforation was significantly related to the *leak* (p=0.008). Intra- abdominal abscess and contamination, wound infection, prolonged post-operative ileus, suture technique and a higher physiological score prior surgery have been documented in the literature as being some of the factors associated with gastric repair *leak* (Eickhoff et al., 2019; Lee et al, 2001). However, in our study gastric *leakage* was observed in male patients with higher POSSUM morbidity score, and almost all patients had antral gastric perforations. The reason for this finding is uncertain.

5.3.1.6 Wound dehiscence

Only one (2.04%) patient had *wound dehiscence* following repair of the perforation on the body of stomach and the *site* was not significantly related to the outcome of *wound dehiscence* (p=0.168).

5.3.1.7 Re-laparotomy

Ten (20.41%) out of 49 gastric perforation peritonitis patients were re-operated and *sites* were; eight pyloric antrum anterior with two being from the body of the stomach. *Re-laparotomy* was the commonest outcome recorded for gastric perforation peritonitis. The rate of *re-laparotomy* was not associated with the *site* of perforation (p=0.754).

5.3.1.8 Mortality

In our study the *mortality* rate for gastric perforation was 32.65% as 16 out of 49 patients with gastric perforation died, and thirteen patients had perforations on the pyloric antrum of the stomach. However, 32.65% was lower than what Sondashi et al. (2011) found at the same hospital eight years ago. The rate has reduced from 37 to 32.65%. Literature has document lower rate than 32.65%. Lohsiriwat et al. (2009) found the overall *mortality* rate for perforated peptic ulcer to be nine percent which was far much lower than what we reported. Sartelli, et al. (2017) emphasized that gastro-duodenal perforation was still a common emergency condition worldwide that has a *mortality* rate as high as 30%. The *mortality* rate for gastric perforation at UTH remains high.

5.3.2 Small Bowel Perforation

5.3.2.1 Site

The majority of small bowel perforations were from the ileum in 36 (90%) followed by the jejunum 3 (7.5%) and duodenum 1 (2.5%). For this study the duodenum was considered under small bowel due to small number of duodenal perforation. Most small bowel perforations were single in 31 out of 40 patients (77.5%). Our finding was similar to Ugwu et al. (2005) study conducted in Nigeria where the small bowel perforations were single in 72.2% patients.

5.3.2.2 POSSUM Score

The *mortality* and morbidity in patients with small bowel perforation were not significantly associated with predicted P-POSSUM *mortality* score (Chi-square=16.80, p=0.331) and the POSSUM predicted morbidity score (Chi-square=4.67, p=0.862) respectively.

5.3.2.3 Size

The commonest size of small bowel perforation was less or equal to 1cm (75%).

5.3.2.4 Procedure

The commonest surgical procedure done for small bowel perforation was freshening of edges and primary repair in 26 patients (65%) followed by ileostomy procedure in 10 patients (25%), resection and primary anastomosis and lastly right hemi-colectomy plus ileo-transverse colon anastomosis.

Our findings were supported by literature as highlighted in a retrospective study conducted in northern India involving 192 patients. Jain et al. (2010) found that primary repair of the small bowel was the most frequent performed procedure (44.0%) followed by ileostomy (25.5%)

and resection-anastomosis (19.3%). Other authors Ilahi et al. (2017) and Wani et al. (2006) found similar results that primary repair was the most common surgery for small bowel perforation. Furthermore Jain et al. (2010) supported our findings of primary repair being the mainstay of surgical management of ileal perforation. Even though literature favoured our findings, Kumar et al. (2011) revealed differing findings of ileostomy being the most common operative procedure done in ileal perforation (75.47%) then primary repair (22.64 %) and lastly resection/anastomosis.

The *site* of perforations, such as the terminal ileum influenced our decision to proceed with a right hemi-colectomy. In the event of multiple small bowel perforations located on the terminal ileum, Sartelli et al. (2017) recommended right hemi-colectomy as the primary repair. Furthermore the same authors and Ugwu et al. (2005) recommended that perforations on both the terminal ileum and caecum also required right hemi-colectomy.

5.3.2.5 Leak

Two (5%) out of 40 patients with repaired small bowel perforations *leaked*; and all were from the ileum. The rate of *leak* was not significantly related to the *site* of perforation (Chi-square=0.65, p=0.885). Several authors have discussed risk factors for bowel *leakage* which include male gender, serum albumin levels, comorbidity, physiological status, prolonged operating time, intra-abdominal contamination, suture technique, presence of abscess at the time of surgery and use of non-steroidal anti-inflammatory drugs after intestinal surgery (Hyman et al, 2007; Lipska et al., 2006; Mäkelä, Kiviniemi, Laitinen, 2003; Rushfeldt et al., 2011). Such report suggest that patients with multiple risk factors have higher risk for anastomotic *leakage*. However, in our study we were unable to determine the risk factors for this finding.

5.3.2.6 Wound dehiscence

Two (5%) out of 40 patients with small bowel (ileal) perforations developed *wound dehiscence* post-operatively. The *wound dehiscence* was not significantly associated with the *site* of the perforation (Chi-square=0.65, p=0.885).

5.3.2.7 Re-laparotomy

Six (15%) out of 40 patients with small bowel perforations were re-explored, and all had ileal perforations. *Re-laparotomy* was the most common morbidity documented for small bowel perforations although the rate of small bowel *re-laparotomy* was not significantly connected to the *site* of perforation (Chi-square=0.81, p=0.846).

5.3.2.8 Mortality

In our study the *mortality* rate for small bowel perforation was 35% as 14 out of 40 patients died, and mostly for ileal perforation in twelve patients. The *mortality* rate for small bowel perforation was significantly associated with the number of perforations (Chi-square value 10.223, p=0.006). The higher the number of small bowel perforations, the high the risk of *mortalit*y. However, the *mortality* was not significantly associated with the *site* of perforation (Chi-square=2.16, p=0.540). Meanwhile according to Sartelli et al. (2017) the *mortality* rate for typhoid ileal perforations could be as high as 60%. However, Ugwu et al. (2005) in northern Nigeria looked at 101 patients with ileal perforations managed over a 10-year period and reported a lower *mortality* rate of 13.9%.

5.3.3 Colonic Perforation

5.3.3.1 Site

There were eight (8%) colonic perforations in our study and four on the sigmoid colon followed by two on the transverse and caecum colon. All were single perforation except in one patient who had two perforations one on the caecum and another on the ascending colon. Most of the colonic perforations were 1cm in estimated size (five patients) and one patient had a perforation more than 4cm in size.

According to Bielecki, Kamiński, and Klukowski (2002) perforations of large bowel are rare and are associated with severe complications. Literature shows a rate as low as 1.27% (Batra et al., 2016) in India although in France in a prospective observational study of patients with secondary peritonitis, Gauzit et al., (2009) found that colon was the commonest cause of perforation peritonitis (32%) followed by appendix (31%). However, they did not look at the size and number of perforations. The rate was higher than what we found in our study, and did not support the findings of colonic perforations as being the commonest cause of GIT perforation.

Many authors including Bielecki et al. (2002) and Faltyn and Jungwirth (1996) have documented the cause of colonic perforation as mainly due to colorectal cancer and colonic diverticulitis. Other causes include artificial injury, local ischaemia, and colonic ulceration.

5.3.3.2 POSSUM score

Concerning the POSSUM score and *site*, the colonic perforation *site* were not significantly associated with predicted P-POSSUM *mortality* score (Chi-square=8.00, p=0.534). The POSSUM predicted morbidity score was not significantly related with the morbidity in patients with colonic perforation (Chi-square=5.80, p=0.446).

5.3.3.1 Leak

Two (25%) out of eight patients with colonic perforations *leaked* post-operatively; one had caecum and another sigmoid colon perforation. *Leak* was the most common outcome for colonic perforation peritonitis. The rate of *leak* was not significantly related to the *site* of colonic perforation (Chi-square=4.00, p=0.261).

5.3.3.2 Wound dehiscence

There were no patients with colonic perforations that developed *wound dehiscence*.

5.3.3.3 Re-laparotomy

One (12.5%) out of eight patients with colonic perforations was re-explored, and had sigmoid perforation. The rate of colonic *re-laparotomy* was not significantly connected to the *site* of perforation (Chi-square=1.143, p=0.767).

5.3.3.4 Mortality

In our study three (37.5%) patients with colonic perforations died within the 30-day period and the causes of death were septicaemia, septic shock and MOF. The *mortality* rate for colonic perforation was not significantly associated with the *site* of perforation (Chi-square= 5.867, p= 0.118). In similar study by Bielecki et al. (2002) a lower overall *mortality* rate of 16.9% was reported. Sartelli et al. (2017) in their review stated that colonic perforation though not as common as small bowel and gastro-duodenal perforations was associated with worse outcomes, and thus recommended radical aggressive approach in management of patients with large bowel perforations.

5.4 Postoperative outcome

The most common postoperative outcome, was in-hospital *mortality* of 36% followed by *re-laparotomy* (17%), repair *leak* (9%) and lastly, *wound dehiscence* (3%). Out of 64 patients who survived, 11were classified as post-operative outcomes. The morbidity rate was 17.19%. More than one outcome was observed in perforation peritonitis patients.

A number of studies done have reported the morbidity rate ranging from 9 to 60%. In India Ilahi et al. (2017) noted that patients had more than one outcome observed in the postoperative period similar to our study. In a similar study, Kumar et al. (2016) found a much higher morbidity rate of 61%. Batra et al. (2016) and Wabwire and Saidi (2014) found the morbidity rate for perforation peritonitis of about 50 per cent. Furthermore, Batra et al. (2016) in Haryana, India, 49.3 % out of 157 patients with perforation peritonitis developed complications. Bali et al. (2014) in a retrospective study in New Delhi, 189 of 400 patients developed postoperative complications. Furthermore the morbidity rate was higher in patients with intestinal perforation (58%) compared to those with gastro-duodenal perforation (32%). In the same period Das et al. (2014) found postoperative complications in 53% of patients following perforation peritonitis. Kumar and Rodriguese (2009) found significant complications of 35.36% following emergency laparotomy. Tolstrup, Watt, and Gögenur (2017) noted that the emergency laparotomy was associated with a high complication rate compared to elective laparotomy. The above studies all reported higher outcomes than what we found at UTH. However, a lower morbidity rate than what we found in our study has been recorded. According to Ayandipo et al. (2016) in Ibadan, Nigeria in a similar study that included 302 perforation peritonitis patients9.2% developed complications in the postoperative period.

In our study the outcome rates varied with geographical location, furthermore it is likely that outcomes could have been less of a problem by early hospital admission. As can be seen from the literature cited in this section perforation peritonitis has a high morbidity rate, and there are several other surgical and medical complications which have not been dealt with here, as our specific objectives were only concerned with *leak, wound dehiscence, and re-laparotomy.*

5.4.1 *Leak*

For this study the rate of GIT repair *leak* was 9% and the *leak* mostly occurred by day five postoperatively. However, some patients *leaked* as early as the third day. The mean day of *leak* was 5.33 ±1.87 days. The stomach was the most frequent GIT *site* to break down after a repair (five patients) followed by the ileum (two patients) and the colon (one patient). The POSSUM predicted morbidity score was not significantly associated with the overall *leak* ($p>0.05$). Pearson Chi-square value =1.256 and p value = 0.740.

Jain et al. (2010) reported GIT *leak* in 11.5% of patients, and noted that with an ileostomy post-operative intestinal *leak* had a better outcome. Arguably the rate of *leak* after simple small bowel closure was high at 14.1% compared to a post small bowel resection and anastomosis 10.8%. During our study at UTH whenever gastrointestinal *leakage* was suspected in the postoperative period, the patient was urgently taken back to theatre for *re-laparotomy*. Such patients who had gastrointestinal *leak* had a poor outcome.

The Literature has documented patient and surgery related factors influencing GIT *leak*. Jain et al. (2010) wrote that patient related factors included presence of sepsis, and tertiary peritonitis; moreover, bowel anastomotic *leakage* has been associated with hypoalbuminaemia, hypotension and peritonitis. Other factors influencing intestinal *leak* include short perforation-to-operation period, volume of peritoneal contaminant fluid, and the health of bowel wall at the time of bowel repair.

5.4.2 Abdominal *Wound Dehiscence*

In this study the rate of abdominal *wound dehiscence* was three percent (3%). Two patients had ileal perforation peritonitis while the other had gastric perforation peritonitis. Pearson Chi-Square of 1.806 and p value 0.614. Generally, there was no significant association between the POSSUM predicted morbidity and the abdominal *wound dehiscence* ($p>0.05$).

A similar rate of 3% was found by Tilt et al. (2018) while in India, Batra et al. (2016) recorded 2.74% as the rate of *wound dehiscence* following laparotomy for peritonitis. A much lower rate of 1.1% was recorded by Riou, Cohen and Johnson (1992) in a 5-year study of 2761 patients undergoing major abdominal surgery. In contrast other authors have found much higher rate of *wound dehiscence*. A similar study by Wabwire and Saidi (2014) done in Nairobi, Kenya documented 18.6% as the rate of *wound dehiscence.* In India, 20% rate of *wound dehiscence* was reported by Kumar et al. (2011) and a further much higher rate of *wound dehiscence* (31.3%) by Jain et al. (2010). Patients who had abdominal *wound dehiscence* were taken back to theatre for wound closure at the appropriate time. Thus prolonging the hospital stay and putting the patient at further anaesthetic and operative risks. According to Col, Soran and Col (1998) it was a serious outcome with the potential of a fatal outcome. It leads to prolonged hospital stays, increased cost to the health care system, and increased *mortality*. With regard to technique of closure, Surgeon and patient-related factors influenced abdominal fascial *wound dehiscence*. Literature has documented patient-related factors for *wound dehiscence*, which include age, gender, diabetes, hypertension, obesity, steroid use, infection, haemodynamic instability, and malignancy (Col et al., 1998; Tilt et al., 2018). Col et al. (1998) added the surgery-related factors of abdominal *wound dehiscence* that included surgeon experience, type of incision and suture material used.

In this study there was no significant relationship between the POSSUM predicted morbidity score and the postoperative complication of *wound dehiscence*.

5.4.3 *Re-laparotomy*

This study has determined that the rate of *re-laparotomy* was 17%, and the mean duration from the first laparotomy to second laparotomy was 9.94 days. The relationship between POSSUM predicted morbidity score and the outcome *re-laparotomy* yielded Chi-square value 3.384 and p value 0.344. Overall, the POSSUM predicted morbidity score was not significantly associated with the outcome of *re-laparotomy* ($p>0.05$).

The earliest day the reoperation was performed was third day and one patient had a *re-laparotomy* done by day 25 after the initial surgery. The indications for *re-laparotomy* were mostly due to gastrointestinal repair *leak* (6 patients), sub-hepatic/sub-hepatic abscess (3 patients), *wound dehiscence* (3 patients), intra-abdominal pus collection, post-operative paralytic ileus (intra-operative), tertiary peritonitis, mechanical intestinal obstruction and gangrenous ileostomy. The patient with intestinal obstruction secondary to small bowel volvulus and adhesions patient had *re-laparotomy* to relieve the mechanical obstruction while peritoneal lavage was done for the intra-abdominal pus collection. Stoma revision was done for gangrenous ileostomy. The commonest GIT *site* to have reoperation was the stomach (10 patients out of 49) followed by ileum (six patients out of 36) and lastly the colon (one out of 8).

Re-laparotomy has been defined as early or late depending on the duration. Early *re-laparotomy* is considered to be one which is performed within two weeks of initial laparotomy. The majority of our patients 14 out of 17 (82.35%) had *re-laparotomy* done within 14 days of the initial laparotomy. Six patients (35.29%) had *re-laparotomy* within a week of the initial surgical operation. During our study re-laparotomies were performed as an

emergency, thus were classified as on-demand *re-laparotomy*. According to Lamme et al. (2002) *re-laparotomy* on demand was performed on patients that required surgical intervention thus preventing unnecessary operations during the recovery phase.

Other authors have documented findings on the rate of *re-laparotomy* and rate of *mortality* for *re-laparotomy*. A systemic review by Lamme et al. (2002) done in Holland favoured on-demand *re-laparotomy* for patients with peritonitis as opposed to planned *re-laparotomy* and the *mortality* rate for planned *re-laparotomy* was 29 per cent while that for on demand *re-laparotomy* was lower at 14 percent. In India a prospective study by Wani et al. (2006) involving 79 patients revealed that the rate of *re-laparotomy* for ileal perforation was five percent. However they concentrated on small bowel perforations and did not report on the stomach, small bowel and large bowel perforations like in our study. Ayandipo et al. (2016) in Ibadan Nigeria, in a retrospective study involving 302 patients found the rate for *re-laparotomy* to be 8.4%. In this study the *re-laparotomy* rate of 17% was double what Ayandipo et al. (2016) found in Nigeria. Even though the rate was almost similar to what Lamme et al. (2002) found in Holland, *re-laparotomy* prolonged hospital stay besides increasing hospital cost.

5.4.4 *Mortality*

Thirty six (36%) patients died during the 30-day study period. Twenty nine (85.29%) out of 34 patients admitted to ICU died while 7 (10.61%) out of 66 patients admitted to the surgical ward died. The POSSUM predicted *mortality* score was positively correlated to physiological score (r= 0.932, p= 0.001), operative score (r= 0.224, p= 0.025), total possum score (r= 0.943, p= 0.001) and significantly predicted *mortality* (p= 0.007).

At the time of death some patients had more than one possible cause of death. Septic shock was the commonest cause of death recorded in 19 patients followed by sepsis in ten patients,

acute kidney injury in nine patients, pneumonia/respiratory failure in three patients, MOF in two patients, septicaemia in one patient, and DIC due to upper GIT bleeding in one patient. For *mortality* by *site*, the stomach was the most common *site* followed by ileum and colon.

In this study the *mortality* rate for perforation peritonitis (36%) was higher than what most authors have documented in the literature. In India, Batra et al. (2016) in a cross-sectional study that included 157 patients with perforation peritonitis over a period of 3 years found the *mortality* rate to be 5.7 %. Whereas according Jain et al. (2010) the percent was 16.6% following non-traumatic small bowel perforation. Similarly, Kumar et al. (2011) in India in a 5-years prospective study involving 887 patients with peritonitis recorded a *mortality* rate 8.2 %. Furthermore, Ilahi et al. (2017) found in-hospital *mortality* rate for perforation peritonitis to be 9.7% even though they noted that it could increase beyond 40% in elderly, patients with comorbidities and those that present late to hospital more than 48 hours. Bali et al. (2014) reported a low rate of 7 %. Watt et al. (2015) in UK, the 30-day *mortality* rate for emergency laparotomy was 12, 4 %. *Mortality* rate for emergency laparotomy tend to be higher than for elective surgery according to Tekkis et al. (2000). In our study at UTH, all patients were operated on as emergencies and one would expect a higher *mortality* rate. However, *mortality* rates as low as 5.7% has been documented in India, and Ayandipo et al. (2016) a 2.4% has been documented following peritonitis in a retrospective study done in Nigeria involving 302 patients managed for peritonitis over a 3- year period. In Nairobi, Kenya, a prospective cross section study involving 70 patients by Wabwire and Saidi (2014) reported 12.9% as the overall *mortality* rate for perforation peritonitis, and the rate was higher in females compared to males. The rate by gender was noted to be 10.7% for males and 21.4% for females. The reverse was noted in our study as we had more males than females. In Lilongwe, Malawi, Samuel et al. (2011) in an observational study that included 190 peritonitis patients, found

that the overall *mortality* rate associated with peritonitis was 15%. Furthermore our *mortality* of 36% still remains high even in the region.

Several studies in the literature did not document the cause of death but recorded the *mortality* rate. Septic shock was the commonest cause of death in our study. Although Kumar et al. (2016) found septicaemia as the most common cause of death, in our study only one patient had septicaemia as the cause following a positive blood culture; this can be an underestimate as blood cultures were not routinely done on all our patients as it was not part of the objective of the study. The septic shock could have arisen due to failure to clear the infecting organism and its toxins, and patients failed to respond to inotropic support in the ICU. Patients presented with complications prior to surgery as noted from preoperative diagnoses. Patients with AKI had no access to haemodialysis an intervention which could have changed the course of patient recovery or outcome. Presence of sepsis could have also influenced the outcome. Espinoza and Rodríguez (1997) noted the presence of sepsis and MOF in 73% perforation peritonitis patients and recorded 30% *mortality* rate. Lastly, concerning the POSSUM score, the POSSUM predicted *mortality* score significantly predicted *mortality* ($p= 0.007$).

5.4.5 Postoperative hospital stay

Is defined as the period or the number of days the patient stayed in the ward following surgical laparotomy; in our study this ranged from three hours (death being the primary end point) to 30 days with the mean of 9.53±6.86 days. In this study, the majority of the patients with perforation peritonitis stayed for 6 days on the ward following surgery. However, the duration did not take into account the number of days prior the laparotomy. According to Brook et al. (2018) the length of stay was the duration from the date of admission into the hospital to the time the patient was discharge or died in the hospital. In our study the thirty-

day follow up commenced on patient initiation into the study and did not take into account the number of days the patients were admitted in hospital prior the laparotomy. Patients came as emergency admission via the casualty section in the Department of Surgery. Others came from the medical and gynaecology admissions following consultation to the Surgery Department.

In India, Jain et al. (2010) recorded 13.7 days as the mean hospital stay after small bowel perforation peritonitis. It was higher than what we found although Jain et al. (2010) looked at small bowel perforation peritonitis. In this study, we included the gastro-duodenal and large bowel perforation peritonitis. In Kenya, in a similar study Wabwire and Saidis (2014) found that the hospital stay for perforation peritonitis was 14 days, and patients that had developed complications during the study had a longer hospital stay of up to 22 days. The 14 days reported by Wabwire and Saidi (2014) was also higher than what was found in this study. However, in our study, patients had hours as low as three as the post-operative hospital stay. In-hospital *mortality* being a primary outcome. Patients that developed complications in the ward or were readmitted during the 30 day study period stayed for a longer duration.

When Watt et al. (2015) studied the outcome of emergency laparotomy in the UK they found that the length of stay ranged from 0 to 198 days, and the mean length of stay was 26 days higher than the 9.53 days we found. Furthermore, patients admitted to the surgical ward had 15 days as the mean length of stay compared to 37 days for patients admitted to ICU.

Concerning readmission within 30-day study period, the readmission rate was 6.25%. Four out of the 64 patients that completed the study were re-admitted for ileostomy reversal post ileostomy, surgical *site* infection, intestinal obstruction and intra-abdominal fluid/pus collection. The intestinal obstruction patient had to be taken to theatre for *re-laparotomy* to

correct the obstruction while the other patient had peritoneal lavage done during the *re-laparotomy*.

5.4.6 Admission to ICU

A third of the perforation peritonitis patients required ICU admission. Thirty four (34%) patients were admitted to ICU during the study period. The mean duration of stay in our intensive care unit was 3.39 ± 2.74 days. The shortest time spent in ICU was three hours post-operative and the longest time was 10 days. The most number of days spent by perforation peritonitis patients in our ICU was two days. The ICU *mortality* rate for perforation peritonitis patients was 85.29%.

In a similar study in Nigeria, Ayandipo et al. (2016) found that 6.5% of 302 patients with peritonitis required intensive care admission. Watt et al. (2015) in a UK study involving 477 patients found that 25 % of patients went to the surgical wards post-operatively while 11 % required ICU management with 64 % requiring high dependence unit level of care post-operatively.

In our study 34 % of patients were admitted to intensive care unit facility and that was much higher than what was reported in Nigeria and the UK. Such large numbers could create a burden on ICU resources and staff. The high number of patients requiring ICU care could be attributed to patients presenting in septic state or presenting late to Surgery Department with complications. Some patients had high *mortality* and morbidity score prior to surgery and required close monitoring and organ support in ICU. Watt et al. (2015) noted that it's logical to state that patients admitted to ICU were more unstable or unwell and therefore they had a higher risk of *mortality*. The majority of our patients were admitted in ICU as their clinical conditions post-operatively dictated such level of care.

The ICU *mortality* rate for perforation peritonitis patients was high at 85.29%. The outcome of *mortality* in ICU was statistically significant (p=0.001). The most common cause of death in ICU was septic shock. Nineteen (65.52%) patients had septic shock at the time of death. In ten patients sepsis was recorded as the cause of death while acute kidney injury in nine patients. The others include MOF, pneumonia and post cardiac arrest. With close patient care and monitoring in ICU one would expect the outcome following ICU admission to be favourable. However, in our study a high number of patients with perforation peritonitis patients died in ICU. Watt et al. (2015) in a UK study had a 30-day *mortality* in ICU of 27 % which is significantly lower than the 85.29 % shown in our study.

5.5 POSSUM Scoring System

The POSSUM marking system is such that the higher the physiological and operative score the more likely that a predicted event will take place. On the basis of this the following were the findings:

The mean preoperative physiological score was 26.68 while the mean operative score was 19. The mean total POSSUM score for general surgery was 45.68±8.98. Patients with high physiological score and operative score were 1.475 and 1.951 more likely to die respectively. The higher the physiological score (p=0.049) and the operative score (p=0.036) the more likely an outcome of *mortality* in a patient with perforation peritonitis. The POSSUM score significantly predicted *mortality* in perforation peritonitis patients (p=0.007).

Although the POSSUM scoring system has been validated in many different surgeries, it was used for the first time at UTH in general surgery. It was applied in perforation peritonitis during this study to predict the outcome. Adesunkanmi et al. (2005) stated that it could help the hospital in applying its resources effectively. According to Copeland (2002) and Kumar et al. (2016) the POSSUM scoring system has been applied in orthopaedic, vascular, urology,

colorectal, oesophageal, laparoscopic and bariatric surgery. Furthermore, Copeland (2002) stated that it can be used in both elective and emergency setting but we applied the POSSUM scoring system for general surgery in emergency setting in our study at UTH.

The benefits of POSSUM score are many even though in this study it failed to significantly predict the morbidity. The POSSUM score could be used to communicate to patients and family member preoperatively to assist in informed consent and management expectations from the surgical intervention. The risks of the surgery can be communicated to the patient with guide from the POSSUM score. According to Wabwire and Saidi (2014) the POSSUM scoring systems aid surgeons in planning treatment, prognosticate on patient outcome in peritonitis, offer early appropriate management and enhance communication with patients and relatives.

CHAPTER 6 : CONCLUSION AND RECOMMENDATIONS

6.1 Conclusion

Perforation peritonitis continues to pose a challenge to surgeons, and has a high morbidity and *mortality*. The overall *mortality* rate for perforation peritonitis at UTH was high (36%).The commonest postoperative outcome was *re-laparotomy* (17%) followed by *leak* (9%) and abdominal *wound dehiscence* (3%). The *mortality* rate was highest in patients admitted to ICU (85.29%) compared to the surgical wards (10.61%). The commonest cause of *mortality* was septic shock.

Stomach perforations occurred in 49 patients. It was the commonest *site* of perforation followed by the ileum, colon, jejunum, duodenum and lastly, the urinary bladder. Out of 49 patients, 16 died and 33 completed the study in whom five *leaked ($p<0.05$),* one developed *wound dehiscence,* and 10 had *re-laparotomy*. The P-POSSUM *mortality* score significantly predicted the outcome of *mortality* in patients with gastric perforation peritonitis ($p<0.05$).The POSSUM morbidity score could not predict *leak, wound dehiscence* and *re-laparotomy* ($p=0.200$).

Small bowel perforations occurred in 40 patients; out of these 14 died post-operatively. Of these forty patients, 36 perforations were in the ileum followed by three in the jejunum and one in the duodenum. In the survivors two *leaked,* two developed *wound dehiscence*, six had *re-laparotomy*. The P-POSSUM *mortality* score and the POSSUM morbidity score were not significantly associated with *mortality* ($p>0.05$) and morbidity ($p>0.05$).

Colon –Eight patients had colonic perforations of whom 3 died; two *leaked,* none developed *wound dehiscence,* one patient had *re-laparotomy* and the remaining two patients recovered uneventfully.

Concerning other *sites*, one patient had urinary bladder perforation, one had combined small and large bowel perforation, and in another the *site* was not identified at the time of surgery.

Lastly, overall the P-POSSUM *mortality* score significantly predicted *mortality* ($p<0.05$) in patients with perforation peritonitis at the UTH even though the POSSUM morbidity score could not significantly predict the outcome of *leak, wound dehiscence* and *re-laparotomy.*

6.2 Recommendations

1. In order to help predict outcome, in particular *mortality,* the use of the POSSUM scoring system for general surgery in perforation peritonitis is recommended.
2. Such a study should be conducted over an extended period of time with a greater number of patients.
3. Further studies are required to determine the preoperative period before admission as it could have influenced the outcome of perforation peritonitis.
4. Demographics should be a subject of a larger study to determine if such factors as gender, age, level of education, and geographic locality could influence the outcome of perforation peritonitis.

REFERENCES

Adesunkanmi, A. R. K., Badmus, T. A., & Ogundoyin, O. (2003). Causes and determinants of outcome of intestinal perforations in a semi urban African community. *Surgical practice, 7*(4), 116-123.

Adesunkanmi, A. R. K., Badmus, T. A., Fadiora, F. O., &Agbakwuru, E. A. (2005). Generalized peritonitis secondary to typhoid ileal perforation: Assessment of severity using modified APACHE II score. *Indian Journal of Surgery, 67*(1).

Ali, N., & Gali, B. M. (2010). Causes and treatment outcome of perforation peritonitis in north eastern Nigeria. *Surgical practice, 14*(3), 92-96.

Ayandipo, O. O., Afwape, O. O., Irabor, D. O., Abdurrazzaaq, A. I., & Nwafulume, N. A. (2016). Outcome of laparotomy for peritonitis in 302 conservative patients in Ibadan, Nigeria. *Annals of Ibadan Postgraduate Medicine, 14*(1), 30-34.

Bali, R. S., Verma, S., Agarwal, P. N., Singh, R., &Talwar, N. (2014). Perforation peritonitis and the developing world. *ISRN Surgery, 2014*.

Bansal, J., Jenaw, R. K., Rao, J., Kankaria, J., & Agrawal, N. N. (2012). Effectiveness of plain radiography in diagnosing hollow viscus perforation: study of 1,723 patients of perforation peritonitis. *Emergency Radiology, 19*(2), 115-119.

Batra, P., Batra, R., & Utaal, M. S. (2016). Possum scoring system for predicting prognosis in patients of perforation peritonitis. *International Surgery Journal, 3*(4), 2115-2119.

Bielecki, K., Kamiński, P., & Klukowski, M. (2002). Large bowel perforation: morbidity and mortality. *Techniques in Coloproctology, 6*(3), 177-182.

Brook, A. J., Mansfield, S. D., Daniels, I. R., & Smart, N. J. (2018). Incisional hernia following closure of loop ileostomy: The main predictor is the patient, not the surgeon. *The Surgeon, 16*(1), 20-26.

Chanda, S. (2015). A study to determine the histological pattern of non-traumatic ileo-cecalperforations and to evaluate the XPERT MTB/RIF assay for rapid diagnosis of intestinal TB at the University Teaching Hospital, Lusaka. Retrieved 19th December, 2017 from http://dspace.unza.zm:8080/xmlui/handle/123456789/4321?show=full

Chatterjee, A. S., & Renganathan, D. N. (2015). POSSUM: a scoring system for perforative peritonitis. *Journal of Clinical and Diagnostic Research: JCDR, 9*(4), PC05.

Clarke, A., Murdoch, H., Thomas, M. J., Cook, T. M., & Peden, C. J. (2011). Mortality and postoperative care after emergency laparotomy. *European Journal of Anaesthesiology (EJA), 28*(1), 16-19.

Code, N. (1949). The Nuremberg Code. *Trials of war criminals before the Nuremberg military tribunals under control council law, 10*, 181-182.

Col, C., Soran, A., & Col, M. (1998). Can postoperative abdominal wound dehiscence be predicted.*Tokai J ExpClin Med, 23*(3), 123-7

Copeland, G. P. (2002). The POSSUM system of surgical audit. *Archives of Surgery, 137*(1), 15-19.

Das, K., Ozdogan, M., Karateke, F., Uzun, A. S., Sozen, S., & Ozdas, S. (2014). Comparison of APACHE II, P-POSSUM and SAPS II scoring systems in patients underwent planned laparotomies due to secondary peritonitis. *Ann ItalChir*, *85*(1), 16-21.

DeRenzo, E. G., & Moss, J. (2006). Writing clinical research protocols: Ethical considerations. Burlington, MA: *Elsevier Academic Press.*

Di Saverio, S., Tugnoli, G., Catena, F., Birindelli, A., Coniglio, C., & Gordini, G. (2015). Surgeon accountability for patient safety in the Acute Care Surgery paradigm: a critical appraisal and need of having a focused knowledge of the patient and a specific subspecialty experience. *Patient safety in surgery*, *9*(1), 38.

Doklestić, S. K., Bajec, D. D., Djukić, R. V., Bumbaširević, V., Detanac, A. D., Detanac, S. D., & Karamarković, R. A. (2014). Secondary peritonitis-evaluation of 204 cases and literature review. *Journal of Medicine and life*, *7*(2), 132.

Eickhoff, R., Eickhoff, S. B., Katurman, S., Klink, C. D., Heise, D., Kroh, A., ... & Binnebösel, M. (2019). Influence of suture technique on anastomotic leakage rate—a retrospective analyses comparing interrupted—versus continuous—sutures. *International journal of colorectal disease*, *34*(1), 55-61.

Eisenstat, M. S., & Hoerr, S. O. (1972). Causes and management of surgical wound dehiscence. *Cleveland Clinic Quarterly*, *39*(1), 33.

Faltyn, J., & Jungwirth, J. (1996). Surgical treatment of the perforated colon with peritonitis. *AnnaliItaliani di Chirurgia*, *67*(2), 211-213.

Gauzit, R., Péan, Y., Barth, X., Mistretta, F., Lalaude, O., & Top Study Team. (2009). Epidemiology, management, and prognosis of secondary non-postoperative peritonitis: a French prospective observational multicenter study. *Surgical Infections*, *10*(2), 119-127.

Ghosh, P. S., Mukherjee, R., Sarkar, S., Halder, S. K., & Dhar, D. (2016). Epidemiology of Secondary Peritonitis: Analysis of 545 Cases. *International Journal of Scientific Study*, *3*(12), 80-85.

Google Maps. (2019). Zambia: Lusaka province and neighbouring provinces, 2019 [Maps]. Retrieved 11th April, 2019 from https://www.google.com/maps/@-15.4273882,28.2889792,8z

Google Maps. (2019). Zambia: Lusaka district showing residences surrounding UTH, 2019 [Maps]. Retrieved 11th April, 2019 from https://www.google.com/maps/@-15.4282983,28.3141276,14z

Guillem, P. (2002). Radiologic pneumoperitoneum without perforation of a hollow viscus. *Journal de Chirurgie*, *139*(1), 5-15.

Hyman, N., Manchester, T. L., Osler, T., Burns, B., & Cataldo, P. A. (2007). Anastomotic leaks after intestinal anastomosis: it's later than you think. *Annals of surgery*, *245*(2), 254.

Ilahi, I., Khan, M. A., Singh, N. K., & Prakash, G. (2017). Validation of the Use of Modified POSSUM Score in Enteric Perforation. *Annals of International Medical and Dental Research*, *3*(4), 53-56.

Jain, B. K., Arora, H., Srivastava, U. K., Mohanty, D., & Garg, P. K. (2010). Insight into the management of non-traumatic perforation of the small intestine. *The Journal of Infection in Developing Countries, 4*(10), 650-654.

Johnson, C. C., Baldessarre, J., & Levison, M. E. (1997). Peritonitis: update on pathophysiology, clinical manifestations, and management. *Clinical Infectious Diseases, 24*(6), 1035-1045.

Kumar, P., & Rodrigues, G. S. (2009). Comparison of POSSUM and P-POSSUM for risk-adjusted audit of patients undergoing emergency laparotomy. *UlusTravmaAcilCerrahiDerg, 15*(1), 19-22.

Kumar, S., Gupta, A., Chaudhary, S., & Agrawal, N. (2011). Validation of the use of POSSUM score in enteric perforation peritonitis-results of a prospective study. *Pan African Medical Journal, 9*(1).

Kumar, A., Suman, S., Kundan, K., & Kumar, P. (2016). Evaluation of POSSUM scoring system in patients with perforation peritonitis. *International Surgery Journal, 3*(4), 2181-2186.

Lamme, B., Boermeester, M. A., Reitsma, J. B., Mahler, C. W., Obertop, H., &Gouma, D. J. (2002). *Meta-analysis of relaparotomy for secondary peritonitis. British Journal of Surgery, 89*(12), 1516-1524.

Langell, J. T., &Mulvihill, S. J. (2008). Gastrointestinal perforation and the acute abdomen. *Medical Clinics of North America, 92*(3), 599-625.

Lee, F. Y. J., Leung, K. L., Lai, P. B. S., & Lau, J. W. Y. (2001). Selection of patients for laparoscopic repair of perforated peptic ulcer. *British journal of surgery, 88*(1), 133-136.

Lipska, M. A., Bissett, I. P., Parry, B. R., & Merrie, A. E. (2006). Anastomotic leakage after lower gastrointestinal anastomosis: men are at a higher risk. *ANZ journal of surgery, 76*(7), 579-585.

Lohsiriwat, V., Prapasrivorakul, S., & Lohsiriwat, D. (2009). Perforated peptic ulcer: clinical presentation, surgical outcomes, and the accuracy of the Boey scoring system in predicting postoperative morbidity and mortality. *World Journal of Surgery, 33*(1), 80-85.

Mäkelä, J. T., Kiviniemi, H., & Laitinen, S. (2003). Risk factors for anastomotic leakage after left-sided colorectal resection with rectal anastomosis. *Diseases of the colon & rectum, 46*(5), 653-660.

Malangoni, M. A., & Inui, T. (2006). Peritonitis–the Western experience. *World Journal of Emergency Surgery, 1*(1), 25.

Mik, M., Magdzinska, J., Dziki, L., Tchorzewski, M., Trzcinski, R., & Dziki, A. (2014). Relaparotomy in colorectal cancer surgery–Do any factors influence the risk of mortality? A case controlled study. *International Journal of Surgery, 12*(11), 1192-1197.

Mulari, K., & Leppäniemi, A. (2004). Severe secondary peritonitis following gastrointestinal tract perforation. *Scandinavian Journal of Surgery, 93*(3), 204-208.

Nachiappan, M., & Litake, M. M. (2016). Scoring Systems for Outcome Prediction of Patients with Perforation Peritonitis. *Journal of Clinical and Diagnostic Research: JCDR, 10*(3), PC01.

Navez, B., Tassetti, V., Scohy, J. J., Mutter, D., Guiiot, P., Evrard, S., & Marescaux, J. (1998). Laparoscopic management of acute peritonitis. *British Journal of Surgery*, *85*(1), 32-36.

Notash, A. Y., Salimi, J., Rahimian, H., Fesharaki, M. S. H., & Abbasi, A. (2005). Evaluation of Mannheim peritonitis index and multiple organ failure score in patients with peritonitis. *Indian Journal of Gastroenterology*, *24*(5), 197.

Nthele, M. A., & Odimba, B. F. K., (2006). A one year study of relaparotomies at the University Teaching Hospital, Lusaka. University of Zambia, Lusaka. Zambia. Retrieved 19th December, 2017 from http://dspace.unza.zm:8080/xmlui/bitstream/handle/123456789/1404/MzazaN0001.PDF?sequence=1&isAllowed=y

Pape, H. C., & Pfeifer, R. (2009). Restricted duty hours for surgeons and impact on residents quality of life, education, and patient care: a literature review. *Patient Safety in Surgery*, *3*(1), 3.

Phiri, P. S., & Odimba, B. F. K., (2007). A study of Perforated Acute Appendicitis at the University Teaching Hospital, Lusaka. Retrieved 15th December, 2017 from http://dspace.unza.zm:8080/xmlui/bitstream/handle/123456789/1426/PhiriPS0001.PDF?sequence=1

Rahbari, N. N., Weitz, J., Hohenberger, W., Heald, R. J., Moran, B., Ulrich, A., ... & Laurberg, S. (2010). Definition and grading of anastomotic leakage following anterior resection of the rectum: a proposal by the International Study Group of Rectal Cancer. *Surgery*, *147*(3), 339-351.

Riou, J. P. A., Cohen, J. R., & Johnson Jr, H. (1992). Factors influencing wound dehiscence. *The American Journal of Surgery*, *163*(3), 324-330.

Robertson, G. S., Wemyss-Holden, S. A., & Maddern, G. J. (2000). Laparoscopic repair of perforated peptic ulcers. The role of laparoscopy in generalised peritonitis. *Annals of the Royal College of Surgeons of England*, *82*(1), 6.

Rushfeldt, C. F., Sveinbjørnsson, B., Søreide, K., & Vonen, B. (2011). Risk of anastomotic leakage with use of NSAIDs after gastrointestinal surgery. *International journal of colorectal disease*, *26*(12), 1501-1509.

Samuel, J. C., Qureshi, J. S., Mulima, G., Shores, C. G., Cairns, B. A., & Charles, A. G. (2011). An Observational Study of the Etiology, clinical presentation and outcomes associated with peritonitis in Lilongwe, Malawi. *World Journal of Emergency Surgery*, *6*(1), 37.

Sartelli, M., Chichom-Mefire, A., Labricciosa, F. M., Hardcastle, T., Abu-Zidan, F. M., Adesunkanmi, A. K., & Ben-Ishay, O. (2017). The management of intra-abdominal infections from a global perspective: 2017 WSES guidelines for management of intra-abdominal infections. *World Journal of Emergency Surgery*, *12*(1), 29.

Saunders, D., Murray, D., Pichel, A. C., Varley, S., Peden, C. J., & members of the UK Emergency Laparotomy Network. (2012). Variations in mortality after emergency laparotomy: the first report of the UK Emergency Laparotomy Network. *British Journal of Anaesthesia*, *109*(3), 368-375.

Singer, M., Deutschman, C. S., Seymour, C. W., Shankar-HAri, M., Annane, D., Bauer, M., … & Hotchkiss, R. S. (2016). The third international consensus definitions of sepsis and septic shock (Sepsis-3). *JAMA, 315*(8), 801-810.

Singh, G., Ram, R. P., & Khanna, S. K. (1998). Early postoperative enteral feeding in patients with nontraumatic intestinal perforation and peritonitis. *Journal of the American College of Surgeons, 187*(2), 142-146.

Sondashi, K. J., Odimba, B. F. K., & Kelly, P. (2011). A cross-sectional study on factors associated with perforated peptic ulcer disease in adults presenting to UTH, Lusaka. *Medical Journal of Zambia, 38*(2), 15-22.

Tekkis, P. P., Kocher, H. M., Bentley, A. J. E., Cullen, P. T., South, L. M., Trotter, G. A., & Ellul, J. P. M. (2000). Operative mortality rates among surgeons. *Diseases of the Colon & Rectum, 43*(11), 1528-1532.

Tilt, A., Falola, R. A., Kumar, A., Campbell, T. J., Marks, J. M., Attinger, C. E., & Evans, K. K. (2018). Operative Management of Abdominal Wound Dehiscence: Outcomes and Factors Influencing Time to Healing in Patients Undergoing Surgical Debridement With Primary Closure. *Wounds: a compendium of clinical research and practice, 30*(11), 317-323.

Tolstrup, M. B., Watt, S. K., & Gögenur, I. (2017). Morbidity and mortality rates after emergency abdominal surgery: an analysis of 4346 patients scheduled for emergency laparotomy or laparoscopy. *Langenbeck'sArchives of Surgery, 402*(4), 615-623.

Ugwu, B. T., Yiltok, S. J., Kidmas, A. T., & Opaluwa, A. S. (2005). Typhoid intestinal perforation in north central Nigeria. *West African Journal of Medicine, 24*(1), 1-6

UTH ICU audit, (2017).

Watt, D. G., Wilson, M. S. J., Shapter, O. C., & Patil, P. (2015). 30-Day and 1-year mortality in emergency general surgery laparotomies: an area of concern and need for improvement? *European Journal of Trauma and Emergency Surgery, 41*(4), 369-374.

Williams, N., O'Connell, P. R., & McCaskie, A. (2018). *Bailey & Love's Short Practice: The Collector's Edition.* Crc Press.

World Medical Association. (2001). World Medical Association Declaration of Helsinki. Ethical principles for medical research involving human subjects. *Bulletin of the World Health Organization, 79*(4), 373.

Yadav, D., & Garg, P. K. (2013). Spectrum of perforation peritonitis in Delhi: 77 cases experience. *Indian Journal of Surgery, 75*(2), 133-137.

Yovtchev, Y., Nicolov, S., Stanilov, N., Ovcharov, I., & Petrov, A. (2010). Relaparotomy-definition and attempt for a new clinical classification. *Trakia Journal of Sciences, 8*(1), 87-90

Zissin, R., Osadchy, A., & Gayer, G. (2009). Abdominal CT findings in small bowel perforation. *The British journal of radiology, 82*(974), 162-171.

APPENDICES

APPENDIX A: Data collection tool

(A) DEMOGRAPHICS:

i. PARTICIPANT ID: ….....

ii. AGE:.....

iii. GENDER (M/F)….:

iv. RESIDENCE: ……

v. EMPLOYMENT: YES/NO……..

vi. EDUCATION LEVEL: PRIMARY/SECONDARY/TERTIARY

(B) i. PREOPERATIVE DIAGNOSIS/INDICATION FOR SURGERY……

ii. INTRAOPERATIVE DIAGNOSIS/FINDINGS: …….

Site of perforation

Site	Number
Gastric	
Duodenal	
Jejunal	
Ileal	
Colonic	
Other (specify)	

iii. OPERATION(s) DONE: ……

iv. POSSUM SCORE: …….

(C) POSTOPERATIVE ASSESSMENT (Tick the outcome as noted)

	WOUND DEHISCENCE	LEAK	RE-LAPAROTOMY	MORTALITY	DURATION OF STAY
DAY 1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
16					
17					
18					
19					
20					
21					
22					
23					
24					
25					
26					
27					
28					
29					
30					

POSSUM SCORE

PHYSIOLOGICAL FACTORS				
SCORE	**1**	**2**	**4**	**8**
Age (years)	≤ 60	61-70	≥71	…
Cardiac sign **CXR**	Normal Normal	Cardiac drugs or steroids …	Oedema; warfarin Borderline cardiomegaly	JVP cardiomegaly
Respiratory signs	Normal	SOB exertion	SOB stairs	SOB rest
CXR	Normal	Mild COAD	Moderate COAD	Any other change
Systolic BP mmHg	110-130	131-170 100-109	≥ 171 90-99	≤ 89
Pulse b/min	50-80	81-100 40-49	101-120	≥ 121 ≤ 39
GCS	15	12-14	9-11	≤ 8
Urea mmol/L	<7.5	7.6-10	10.1-15	≥ 15.1
Sodium mEq/L	>136	131-135	126-130	≤ 125
Potassium mEq/L	3.5-5	3.2-3.4 or 5.1-5.3	2.9-3.1 or 5.4-5.9	≤2.8 or ≥6
Haemoglobin g/dl	13-16	11.5-12.9 or 16.1-17	10-11.4 17.1- 18	≤9.9 ≥18.1
White cell count **x10¹²/L**	4-10	10.1- 20.0 3.1 – 3.9	≥20.1 ≤ 3	…
ECG	Normal	…	Atrial fibrillation (60-90)	Any other change

OPERATIVE SEVERITY				
SCORE	**1**	**2**	**4**	**8**
Operative magnitude	Minor	Intermediate	Major	Major +
No. of operation within 30days	1	..	2	>2
Blood loss per operation, ml	<100	101-500	501-999	>1000
Peritoneal contamination	No	Serious	Local pus	Free bowel content, pus or blood
Presence of malignancy	No	Primary cancer only	Node metastases	Distant metastases****
Timing of operation	Elective	…	Emergency resuscitation possible, operation <24hours	Emergency immediate, operation <2hours

Distant metastases**** *....where indicated to be determined prior to discharge*

PARTICIPANT ID

Gender	Male……. Female……..
Date Of Birth(Age)	
Firm	
Ward	
Admission Date	……/……/……..
Operation Date(s)	……../……/……
Date Discharged	……../……/……..
Possum Score	

COAD: Chronic Obstructive Airway Disease

CXR: Chest X-Ray

ECG: Electrocardiogram

GCS: Glasgow Coma Scale

JVP: Jugular Venous Pressure

SOB: Shortness of Breath

APPENDIX B: Consent form

By signing below, I give consent to participate in this study and that the purpose of this study has been explained to me and I understand the purpose of this study. In addition, I understand that participation in this study is completely voluntary and I can withdraw from the study at any time without giving any explanation. I am aware that my rights and privacy will be maintained throughout the study period and beyond.

The preoperative checklist will be conducted in accordance with the hospital regulations.

I _____ (Names) agree to participate in the study.

Sign/thumbprint_____ Date :___/___/_____(Participant)

Sign _____Date: ___/___/_____ (Witness)

Sign_____ Date: ___/___/_____ (Researcher)

APPENDIX C: Participant information sheet

Title of the study: A Study to investigate the thirty day outcome of perforation peritonitis at the University Teaching Hospitals, Lusaka Zambia.

Introduction

I am Dr.Kabongo M. C. Kizito, from the University of Zambia, School of Medicine, Department of Surgery, and pursuing a Master of Medicine in General Surgery. You are invited to participate in the study. Read through the following information carefully. Take time to decide whether or not to take part in the study. This study aims to find out the thirty day outcome of infection in the abdominal cavity because of a hole in the gastrointestinal tract at the University Teaching Hospitals, Surgery Department, Lusaka.

Purpose of the study

The purpose of the study is to find out the outcomes that occur within thirty days after the operation for infection in the abdominal cavity because of a hole in the gastrointestinal tract. The result of the study will help the Department of Surgery in surgical decision making thereby improving the outcome of patients undergoing emergency laparotomy (abdominal operation). It will help prevent or reduce number of postoperative outcomes arising from surgeries for infection in the abdominal cavity.

Procedure

The study will involve you answering a few questions on where you live, work, level of education and specific questions on the problems you are complaining of. You will be required to sign a written consent form to take part in the study. The treatment of your condition requires an operation to identify and control the source of the infection, repair the hole, and irrigate the peritoneal cavity with saline (sterile salt water).

After the operation you will be admitted and followed up in the surgical ward. Participation in this study will not any way affect the quality of care you receive or management of your condition. Currently, at the University Teaching Hospitals there is no alternative treatment to laparotomy (abdominal operation) for your condition.

Potential Benefits

There will be no monetary or other benefits for participating in this study. However, the information gained from the study will in future be used to improve the quality of care offered to other patients with this condition. Clinically relevant information to your immediate or future health will be available to enhance your long term management.

It is hoped that this work will have a beneficial impact on how people with infection in the abdominal cavity are managed.

Potential Risks

There is no risk attributed to participating in this study as all procedures done are part of the standard of care for patients with this condition. The distress associated with the surgery will be reduced with appropriate management and should outcomes arise the staff are ready to offer the best of care to you. You are free to contact the doctors looking after you at any time.

Rights of a research Participant

Participation in this study is completely voluntary. You have the right to withdraw from the study at any time and such a decision will not in any way affect the treatment, quality and standard of care given to you. It is up to you to decide whether or not to take part in the study. The researcher may need to stop your contribution to the research project, however, the surgical care offered to you will remain unaltered.

Confidentiality

All the information obtained from you will only be used for purposes of this study and will be kept strictly confidential. Personal information will not be released to anyone. You will not be identifiable in any report or publication. Results of the research will be published as per school of medicine Research and Ethics regulations.

Conflict of interest

There is no conflict of interest

Sponsor/ funding

It is part of the postgraduate degree requirement to conduct research and the researcher will fund the project.

Approval

This study has been ethically approved by the ERES Converge Institution Review Board.

Contact for further information

If you have any other questions about this study or you wish to have further clarification you may contact:

The Principal Investigator
Dr.Kabongo M. C. Kizito
University of Zambia
School of Medicine
Department of surgery
Lusaka, Zambia
Cell: +260977499807

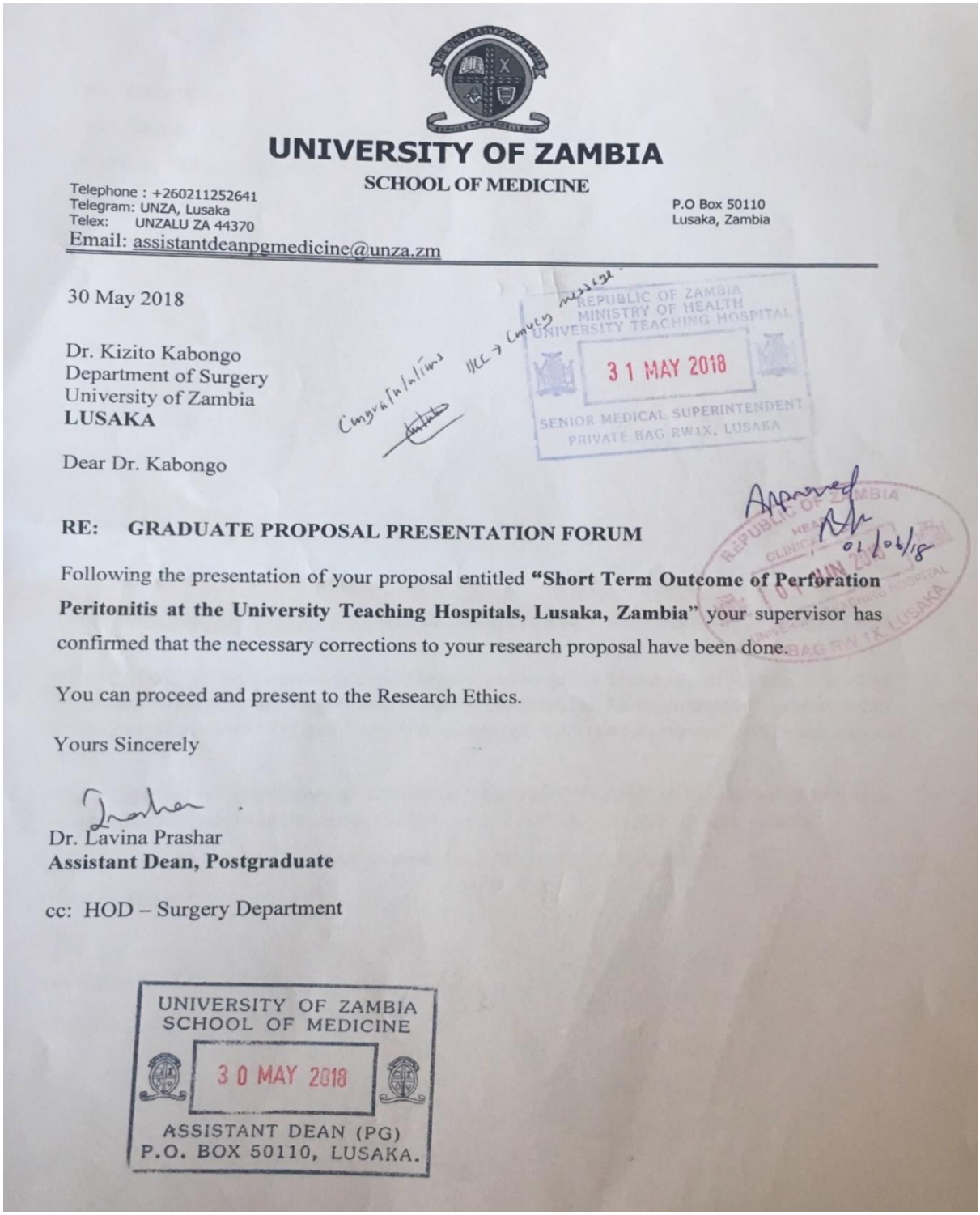
For concerns regarding ethical issues in conducting this study contact.

The Chairman
ERES CONVERGE IRB
33 Joseph Mwilwa Road
Rhodes Park
LUSAKA
Tel: 0955 155633/4
E-mail: eresconverge@yahoo.co.uk
Thank you for taking part in this research.

The research supervisor

Professor KrikorErzingatsian
School of Medicine,
Surgery Department,
Lusaka, Zambia.
Cell: +260974045633

APPENDIX D: GPPF Clearance



UNIVERSITY OF ZAMBIA

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P.O Box 50110
Lusaka, Zambia

30 May 2018

REPUBLIC OF ZAMBIA
MINISTRY OF HEALTH
UNIVERSITY TEACHING HOSPITAL
31 MAY 2018
SENIOR MEDICAL SUPERINTENDENT
PRIVATE BAG RW1X, LUSAKA

Dr. Kizito Kabongo
Department of Surgery
University of Zambia
LUSAKA

Dear Dr. Kabongo

RE: GRADUATE PROPOSAL PRESENTATION FORUM

Approved
01/06/18

Following the presentation of your proposal entitled **"Short Term Outcome of Perforation Peritonitis at the University Teaching Hospitals, Lusaka, Zambia"** your supervisor has confirmed that the necessary corrections to your research proposal have been done.

You can proceed and present to the Research Ethics.

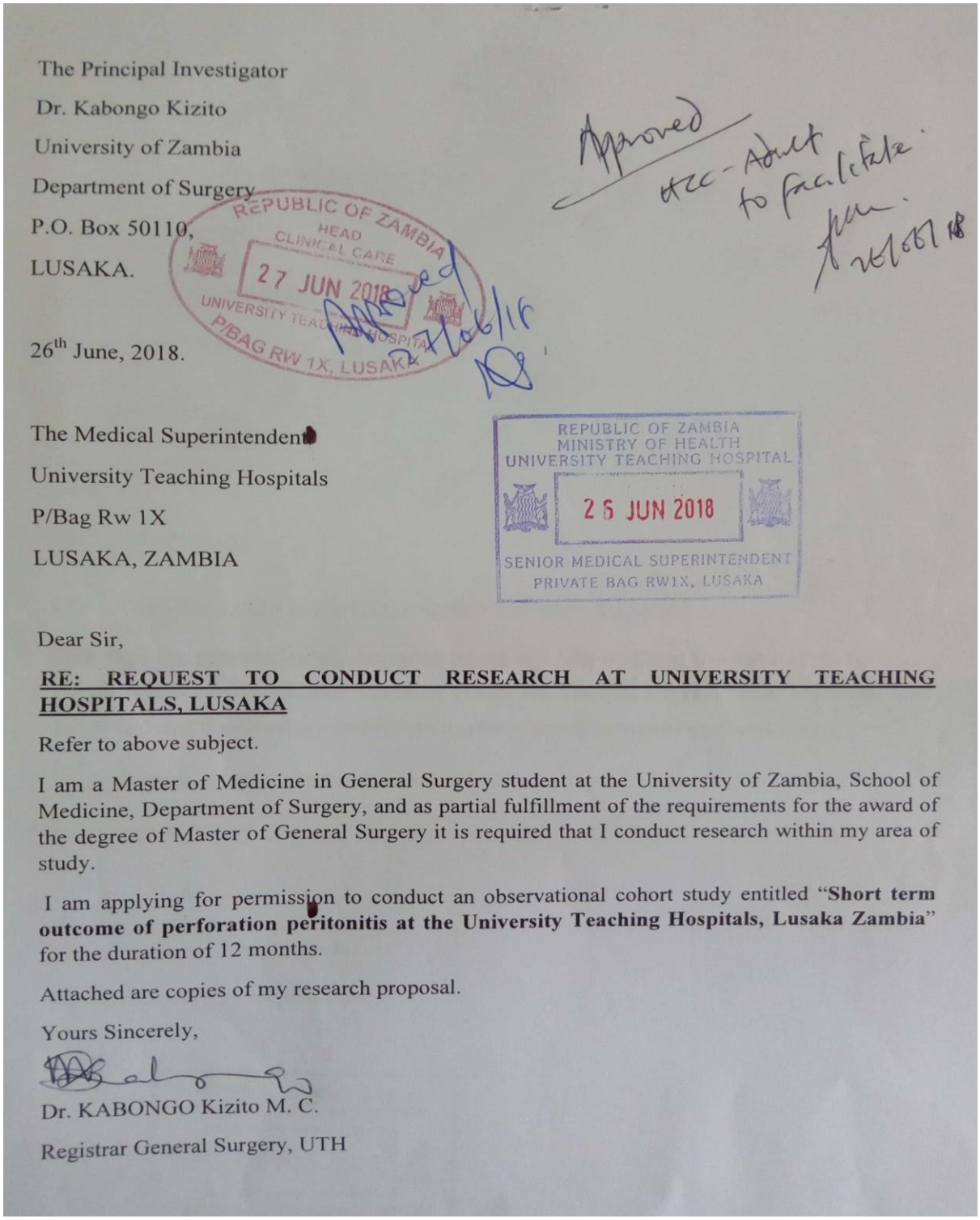
Yours Sincerely

Dr. Lavina Prashar
Assistant Dean, Postgraduate

cc: HOD – Surgery Department

UNIVERSITY OF ZAMBIA
SCHOOL OF MEDICINE
30 MAY 2018
ASSISTANT DEAN (PG)
P.O. BOX 50110, LUSAKA.

APPENDIX E: Permission letter



The Principal Investigator
Dr. Kabongo Kizito
University of Zambia
Department of Surgery
P.O. Box 50110,
LUSAKA.

Approved
UCC - Advert to facilitate

REPUBLIC OF ZAMBIA
HEAD
CLINICAL CARE
27 JUN 2018
UNIVERSITY TEACHING HOSPITAL
P/BAG RW 1X, LUSAKA

Approved
27/06/18

26th June, 2018.

The Medical Superintendent
University Teaching Hospitals
P/Bag Rw 1X
LUSAKA, ZAMBIA

REPUBLIC OF ZAMBIA
MINISTRY OF HEALTH
UNIVERSITY TEACHING HOSPITAL
25 JUN 2018
SENIOR MEDICAL SUPERINTENDENT
PRIVATE BAG RW1X, LUSAKA

Dear Sir,

RE: REQUEST TO CONDUCT RESEARCH AT UNIVERSITY TEACHING HOSPITALS, LUSAKA

Refer to above subject.

I am a Master of Medicine in General Surgery student at the University of Zambia, School of Medicine, Department of Surgery, and as partial fulfillment of the requirements for the award of the degree of Master of General Surgery it is required that I conduct research within my area of study.

I am applying for permission to conduct an observational cohort study entitled "**Short term outcome of perforation peritonitis at the University Teaching Hospitals, Lusaka Zambia**" for the duration of 12 months.

Attached are copies of my research proposal.

Yours Sincerely,

Dr. KABONGO Kizito M. C.
Registrar General Surgery, UTH

APPENDIX F: Ethical Approval

ERES CONVERGE

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Rhodes Park, Lusaka
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I.R.B. No. 00005948
F.W.A. No. 00011697

16th July, 2018

Ref: No. 2018-Jun-010

The Principal Investigator
Dr. Kizito M. C. Kabongo
The University of Zambia
Dept. of Surgery
P.O. Box 50110,
LUSAKA.

Dear Dr. Kabongo,

RE: THIRTY DAY OUTCOME OF PERFORATION PERITONITIS AT THE UNIVERSITY TEACHING HOSPITALS, LUSAKA, ZAMBIA.

Reference is made to your corrections dated 9th July, 2018. The IRB resolved to approve this study and your participation as principal investigator for a period of one year.

Review Type	**Ordinary**	Approval No. **2018-Jun-010**
Approval and Expiry Date	**Approval Date:** 16th July, 2018	**Expiry Date:** 15th July, 2019
Protocol Version and Date	Version-Nil	15th July, 2019
Information Sheet, Consent Forms and Dates	• English.	15th July, 2019
Consent form ID and Date	Version - Nil	15th July, 2019
Recruitment Materials	Nil	15th July, 2019
Other Study Documents	Observations.	15th July, 2019
Number of participants approved for study	100	15th July, 2019