PATTERN, MANAGEMENT AND OUTCOME OF INTESTINAL OBSTRUCTION AT THE MOI TEACHING AND REFERRAL HOSPITAL

BY:

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DECLARATION

Declaration by the Candidate

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DEDICATION

I dedicate this work to all my teachers who over the years have made great sacrifices in modelling me to become a better person and doctor and also to my dear parents for the immense effort in educating me.

DISCLOSURE

The researcher did not receive any outside funding or grant in support for this study. Neither he nor members of his immediate family receive payment or other benefits or commitment or agreement to provide such benefits from a commercial entity.

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ABSTRACT

BACKGROUND: Intestinal obstruction is severe impairment or complete failure in propagation of intestinal contents in the normal cranio-caudal direction. It is a common surgical emergency with an incidence of 8.8/100,000/year in Uasin Gishu County. The outcomes vary in different centers. Despite MTRH providing care for patients with intestinal obstruction for years, no data exists on the outcome among these patients. This study aimed at bridging this gap.

OBJECTIVE: To determine the pattern, management and outcome in patients with intestinal obstruction at the MTRH.

METHODOLOGY: *Study site*: The surgical wards and accident/ emergency department at the MTRH. *Subjects*: Patients diagnosed with intestinal obstruction and met the selection criteria presenting at the MTRH between 15th Sept. 2013 and 15th Dec. 2014. *Study design*: Hospital-based prospective study. *Sampling method*: Purposive consecutive sampling. *Sample size*: A total of 199 patients were eligible during the study period and all were included. *Data management*: Data was collected using interviewer administered structured questionnaires through interviews, clinical examination and review of medical records. The data was entered in MS Access, coded and SPSS version 21 used for analysis. Statistical tests used in analysis were Chi square, student-t test and Fisher's exact tests while logistic regression was used to control for confounders.

MAIN RESULTS: A total of 199 patients were studied. Among them 80 (40.2%) were children (≤12 years). The male/female ratio was 1.4:1. The median age was 22 years (mean and SD of 25.8 ±24.7years and range of 1 day to 86 years). Majority (84.3%) of the patients had a late presentation to hospital (>24 hours). Many (93 patients, 46.7%) of the patients studied had an acute presentation (less than 4 days) with a mean duration of illness of 2.03±0.9 days. The main presentation was abdominal distension (58.6%) and vomiting (55.1%). Among children, anorectal malformation (35cases, 43.8%) and intussusception (22cases, 27.5%) were the commonest causes of obstruction. Adhesion (39cases, 32.8%) and bowel volvulus (31cases, 26.1%) were the commonest causes among subjects aged >12 years. Surgery was done in 164 patients (82.4%) and gangrene was found in 23% of these. Intussusception was the commonest diagnosis among patients with gangrene. Among the patients treated surgically, only 38.8% and 57.3% received adequate fluids in the pre- and post-operative periods respectively. None of the patient studied had adequate nasogastric tube management. Complications occurred in 47 (23.6%) patients and the mean length of stay was 8.5±6.7days (range 1-46 days). The overall mortality rate was 15% (18.8% in children and 12.6% in patients > 12 years). The main cause of death was septicaemia. Bowel gangrene was the only factor among those evaluated that significantly influenced outcome after control for confounders (*p*-0.015).

CONCLUSION: Adhesions, ARM, volvulus and intussusception are the common causes of intestinal obstruction at MTRH. Bowel gangrene is the single independent determinant of outcome in patients with intestinal obstruction.

RECOMMENDATION: Timely diagnosis and management of intestinal obstruction should be encouraged to reduce the rate of bowel gangrene. Improvement in supportive treatment, including fluid therapy and bowel decompression, among patients with intestinal obstruction at MTRH may help improve the outcome.

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LIST OF ABBREVIATION AND ACRONYMS

AIDS- Acquired Immunodeficiency Syndrome

ARM- Anorectal Malformations

ASA – American Society of Anaesthesiologists

CT- Computed Tomography

CTEV- Congenital tallipes eqinovarus

CVA- Cerebral vascular disease

DM- Diabetes Mellitus

DVT- Deep venous thrombosis

HIV- Human Immunodeficiency Virus

ICU- Intensive care unit

IREC-Institutional research and ethics committee

LBO- Large bowel obstruction

MTRH- Moi Teaching and Referral Hospital

NEC- Necrotizing enterocolitis

NGT- Nasogastric tube

NPV- Negative predictive value

SBO- Small bowel obstruction

SEP- Sclerosing encapsulating peritonitis

SLE- Systemic lupus erythematosus

SPSS- Statistical package for the social sciences

SSI- Surgical site infection

TB- Tuberculosis

TPN- Total parenteral nutrition

US- Ultrasound

WBC- White blood cell

OPERATIONAL DEFINITION OF TERMS

Intestinal obstruction-presence (in a patient) of the following cardinal features in various combinations as identified (by a trained clinician) at presentation to hospital or at any point during hospital stay: Abdominal distension, constipation, vomiting and abdominal pain with or without supportive radiographic findings.

Management- clinical evaluation, investigations and treatment given to patients

Pattern- aetiology and duration (acute <4days; sub-acute 4-14 days or chronic >14days) of intestinal obstruction

Outcome- the eventual results of management of patients

CHAPTER ONE: INTRODUCTION

1.1 BACKGROUND INFORMATION

Intestinal obstruction is impairment of passage of intestinal contents in the usual cephalo-caudal direction (Asad et al., 2011; Ooko, Sirera, Saruni, Topazian, & White, 2015; Qureshi & Khan, 2008) beyond the point of obstruction. It is a common general surgical emergency (Ahmed, Dauda, Garba, & Ukwenya, 2010; Chalya, Mabula, Chandika, & Giiti, 2014; Ooko et al., 2015; Ullah, Khan, Mumtaz, & Naseer, 2011) and is the leading cause of morbidity and mortality from all causes of acute abdomen. In Uasin Gishu County, the incidence of intestinal obstruction has been reported as 8.8/100,000/ year (Jumbi, 2014) .There are several causes of intestinal obstruction but the prevalence of each cause varies from region to region (Lawal, Olayinka, & Bankole, 2005; Ooko et al., 2015). Variability in dominance among these causes in any specific region also occurs from time to time(Asad et al., 2011).

Patients with intestinal obstruction present with various symptoms. The cardinal symptoms are abdominal pain, vomiting, constipation (or obstipation) and abdominal distension (Asad et al., 2011; Di Saverio et al., 2013; Kahi & Rex, 2003; Ullah et al., 2011). The sequence of presentation and severity of each symptom varies from patient to patient depending on the level and degree of obstruction and duration since onset of the illness among other things. Other signs such as tachycardia, hypotension and fever may also accompany the illness. Irrespective of the cause of obstruction, the common pathophysiology is reduction of intravascular volume which leads to various physiological derangements(Kahi & Rex, 2003). These abnormalities in homeostasis further add to the complexity in patient presentation.

Diagnosis of intestinal obstruction is largely clinical, through history taking and physical examination. However, plain abdominal radiographs have over the years proved most useful in confirming the diagnosis (Di Saverio et al., 2013; Kahi & Rex, 2003). Other investigations that may prove useful are ultrasound, CT scan and contrast studies(Di Saverio et al., 2013). Laboratory tests such as full blood picture and Urea, Electrolytes and Creatinine are non-specific but are often done to assess the physiological derangements that arise in this disease process(Kahi & Rex, 2003). Accurate and timely diagnosis must be made in order to expedite management of these patients before the dreaded complication of strangulation sets in(Kuremu & Jumbi, 2006).

Management of intestinal obstruction starts with resuscitation before definitive treatment is initiated. Resuscitation entails bowel rest by nasogastric tube decompression while the patient takes nothing by mouth, intravenous fluid and parenteral antibiotics. Bowel decompression reduces continued bowel wall ischaemia and the risk of aspiration. Proper and effective bowel decompression is achieved with the use of appropriate size tube which must be persistently present and patent together with accompanying serial aspiration. The aspirate must be replaced with appropriate intravenous fluid as part of ongoing losses. Intravenous fluid therapy follows the surgical principles of replacing the deficit, ongoing losses and maintenance fluid. Adequacy of fluid therapy can be objectively assessed though urine output. It is considered adequate when urine production is 1-2ml/kg body weight per hour. Crystalloids are generally the preferred fluid of choice to replace the body water and electrolytes. Parenteral antibiotics are targeted at various micro-organisms that have been shown to proliferate in the bowel and translocate across the bowel wall in intestinal obstruction. Gram-negative and anaerobic bacteria are most dominant. The choice of such antibiotics should be guided by known regional sensitivity patterns for various suspected organisms.

Definitive treatment of these patients is either non-operative (conservative) or operative(Di Saverio et al., 2013). Selection of mode of therapy largely depends on the cause of the obstruction and severity of the illness among other factors. This can be a difficult decision to make(Di Saverio et al., 2013; Kahi & Rex, 2003). Some patients are eventually operated on after a period of conservative management. These patients are considered to have "failed" conservative management. Regardless of the definitive mode of treatment chosen, monitored fluid and electrolyte resuscitation, bowel decompression and antimicrobial therapy remain standard for all patients with intestinal obstruction.

Several factors determine the prognosis of this illness. Among them are the cause of the obstruction, patient's demographic factors such as age and notably the interval between onset of the illness and definitive treatment. This interval often determines whether or not strangulation of the bowel has set in (Chalya et al., 2014; Di Saverio et al., 2013; Lawal et al., 2005). The presence of gangrene or perforation is a major determinant of outcome(Ooko et al., 2015; Stewardson, Bombeck, & Nyhus, 1978). The overall mortality rate has been estimated at 10- 15% but figures as high as 30% have been reported(Chalya et al., 2014; Ooko et al., 2015).

The aim of this study was to determine the hospital outcomes in patients with intestinal obstruction managed at MTRH. Various factors affecting these outcomes and their impact were also assessed. The outcomes were assessed through morbidity and mortality rates and duration of hospital stay to the time when a decision to discharge the patient was made.

1.2 Problem statement

1.2.1. Significance of this study

Intestinal obstruction contributes to a sizable proportion of all patients admitted in the surgical wards the world over and has remained a common diagnosis over the years. The incidence of intestinal obstruction has been reported as 8.8/100,000/yr in Uasin Gishu County (Jumbi, 2014). The outcomes in these patients vary from centre to centre as demonstrated in various researches and are influenced by patient and institutional factors. In developing countries, like Kenya, many challenges are encountered in managing these patients and the outcomes remain poor. Despite the MTRH having been offering treatment for intestinal obstruction for many years, the pattern and outcomes (morbidity and mortality) of these patients remain unknown. This necessitates local research on this disease not only as an audit of our care but also to generate more information on this complex disease process.

1.2.2. Scope of the study

The study was aimed at elucidating the various immediate outcomes in patients managed for intestinal obstruction at the MTRH and the various factors involved. The patients were followed from the time of their admission until a decision to discharge them was made or until their death.

1.2.3. Expected impact

There is need to develop institutional guidelines to aid in proper management of the many patients with intestinal obstruction presenting in different surgical units. Such guidelines are based on already existing data on outcomes of the said condition. While intestinal obstruction is a common surgical condition, only little information is available

on the various outcomes seen in these patients managed at MTRH. This study will fill part of this information gap.

1.3. Justification statement

Intestinal obstruction is a common surgical emergency in many parts of the world. It leads to significant but variable levels of morbidity and mortality. While the general subject of intestinal obstruction has been widely researched and published on in different parts of the world, developing countries have contributed little to this body of knowledge. In line with this, only scanty data is available on the outcomes in such patients managed in different hospitals in Kenya. The causes are multiple, with different parts of the world reporting different patterns of this condition. This variation in patterns may partly explain the variability in outcomes reported in different regions of the world. Furthermore, the patterns of intestinal obstruction keep changing over time and this necessitates periodical studies in each region to evaluate the trend. This study aimed at determining the current patterns, related outcomes and the factors influencing such outcomes in cases of intestinal obstruction at the MTRH. The information generated will not only be useful to the MTRH in its quest to improve patient care but also contribute to the body of knowledge in management of this common and yet challenging surgical emergency.

1.4. Research question

What is the pattern, management and outcomes in patients with intestinal obstruction at the MTRH?

1.5. Objectives:

1.5.1 Broad objective:

To determine the pattern, management and outcomes in patients with intestinal obstruction at the MTRH

1.5.2 Specific objectives

1.To determine the pattern of intestinal obstruction at the MTRH.

2. To describe the management of intestinal obstruction at the MTRH

3.To describe the various outcomes in patients managed for intestinal obstruction at the MTRH.

4.To determine the factors associated with the various outcomes in patients with intestinal obstruction at the MTRH

CHAPTER TWO: LITERATURE REVIEW

2.1 Introduction

Bowel obstruction occurs when the normal forward propulsion and passage of intestinal contents does not occur or is seriously impaired (Asad et al., 2011; Ashley, 2007; Jackson & Raiji, 2011; Khan, Shah, & Ali, 2014; Ooko et al., 2015; Qureshi & Khan, 2008). This can occur at any level along the bowel(Jackson & Raiji, 2011). It is one of the leading causes of surgical admissions worldwide and has remained a challenge over the years (Ahmed et al., 2010; Asad et al., 2011; Hayanga, Bass-Wilkins, & Bulkley, 2005; Jackson & Raiji, 2011; Ooko et al., 2015; Ullah et al., 2011). It is one of the more common acute abdominal emergencies and is associated with significant morbidity and mortality, especially if it has progressed to bowel ischemia (Chalya et al., 2014; Fischer, Bland, & Callery, 2006; Jackson & Raiji, 2011; Jumbi, 2014; Kadhim J. O. , 2011; Ntakiyiruta & Mukarugwiro, 2009; Oladele, Akinkuolie, & Agbakwuru, 2008; Souvik, Zahid Hossein, Amitabha, Nilanjan, & Udipta, 2010). It may be difficult to manage even in experienced hands(Qureshi & Khan, 2008).

Mechanical intestinal obstruction should be differentiated from paralytic ileus (functional obstruction), which is associated with a wide variety of intra-peritoneal and extra-peritoneal processes that interfere with the normal motility of the intestine and that resolve spontaneously once the inciting cause has been eliminated(Fischer et al., 2006; Ooko et al., 2015). Patients with paralytic ileus must therefore not be subjected to unnecessary surgery which would only increase their morbidity. On the other hand, in patients with mechanical obstruction, surgery should not be delayed unnecessarily.

2.2 Presentation

Intestinal obstruction is a common surgical condition and a leading cause of emergency surgical admissions (Ahmed et al., 2010; Ameh & Chirdan, 2000; Asad et al., 2011;

Chalya et al., 2014; Hayanga et al., 2005; Jackson & Raiji, 2011; Maglinte, Kelvin, Rowe, Bender, & Rouch, 2001; Oladele et al., 2008; Ongom, Opio, & Kijjambu, 2014; Souvik et al., 2010; Tumusiime, Kakande, & Masiira, 2009; Ullah et al., 2011). It affects all age groups(Ntakiyiruta & Mukarugwiro, 2009; Ogundoyin, Afolabi, Ogunlana, Lawal, & Yifieyeh, 2009). Both sexes are affected and the presentation is often acute (<4days). However, some patients have a sub-acute (4-14days) or even chronic (>14days) presentation. This is largely determined by the underlying cause of the obstruction. It is a challenging condition to manage(Jackson & Raiji, 2011) and without treatment, the case fatality rate is high(Jumbi, 2014; Ntakiyiruta & Mukarugwiro, 2009).

2.3. Classification and aetiology of intestinal obstruction

Intestinal obstruction is classified according to duration since onset as acute, chronic or acute-on-chronic; either mechanical or functional; simple or strangulating and completeness of obstruction into either complete or incomplete(Asad et al., 2011; Chalya et al., 2014; Di Saverio et al., 2013; Heneyke, Smith, Spitz, & Milla, 1999; Kahi & Rex, 2003; Khan et al., 2014; Ogundoyin et al., 2009; Ooko et al., 2015; Ullah et al., 2011). It is further be classified anatomically into either large or small bowel obstruction(Jackson & Raiji, 2011; Kahi & Rex, 2003) as well as the source of the obstruction in relation to bowel lumen into extramural, mural or intraluminal (Khan et al., 2014). About 80% of bowel obstructions occur in the small intestine; the other 20% occurring in the colon (Ashley, 2007; Maglinte et al., 2001; Malik, Shah, Pathan, & Sufi, 2010; Ogundoyin et al., 2009).

The pattern of intestinal obstruction varies with communities, age groups and geographical areas(Ameh & Chirdan, 2000; Asad et al., 2011; Chalya et al., 2014; Hayanga et al., 2005; Kadhim J. O. , 2011; Lawal et al., 2005; Ogundoyin et al., 2009; Oladele et al., 2008; Ooko et al., 2015; Souvik et al., 2010; Ullah et al., 2011).It affects

all age groups though the commonest causes vary with age. In infants and young children, congenital causes of bowel obstruction are more (particularly anorectal malformations and bowel atresia) together with other conditions such as Hirschsprung's disease and intussusception (Ameh & Chirdan, 2000; Millar, Rode, & Cywes, 2000; Ogundoyin et al., 2009; Ongom et al., 2014). Intestinal atresia and stenosis may be more commoner in Africa than the USA but with low survival rates(Millar et al., 2000). While intussusception is common in childhood, adult intussusception is rare (5% of all cases of intussusception) and accounts for 1-5% of IO in adults(Marinis et al., 2009).

Various regions in the world report different patterns in the causes of intestinal obstruction and this changes with time as noted by many authors (Asad et al., 2011; Kadhim J. O. , 2011; Khan et al., 2014; Lawal et al., 2005; Maglinte et al., 2001; Ogundoyin et al., 2009; Oladele et al., 2008; Ooko et al., 2015; Souvik et al., 2010; Ullah et al., 2011). Such knowledge of the common causes in a particular area may help in expediting diagnosis and care of such patients especially in resource-constrained regions like Kenya where diagnostic facilities are scarce(Ooko et al., 2015).

In as many as 60-70% of all patients in the United States and other developed countries with small bowel obstruction, adhesions are the cause, usually secondary to previous abdominal operations(S.-C. Chen et al., 2005; Di Saverio et al., 2013; Duron et al., 2008; Fischer et al., 2006; Hayanga et al., 2005; Jackson & Raiji, 2011; Jumbi, 2014; Kahi & Rex, 2003; Malik et al., 2010; Stewardson et al., 1978; Ullah et al., 2011). It is also the overall leading cause of IO in the world(Ahmed et al., 2010; Maglinte et al., 2001; Qureshi & Khan, 2008) particularly in the adult population. Adhesions may cause obstruction in the immediate post-operative period or years later(Kuremu & Jumbi, 2006). Their formation appears to be especially frequent after appendectomy, gynaecologic surgery, total abdominal colectomy, abdomino-perineal resection, and

laparotomy for blunt or penetrating abdominal trauma (S.-C. Chen et al., 2005; Di Saverio et al., 2013; Fischer et al., 2006; Hayanga et al., 2005; Jackson & Raiji, 2011; Kahi & Rex, 2003; Khairy et al., 2005; Kuremu & Jumbi, 2006; Lawal et al., 2005; Malik et al., 2010).

Adhesion can start forming within hours of surgery(Di Saverio et al., 2013) but may not cause obstruction until much later in life(Kuremu & Jumbi, 2006). Since adhesive intestinal obstruction has become an important surgical diagnosis world-over, there is need for surgeons to perform surgeries meticulously in an attempt to reduce the formation of adhesions. The main issues are to reduce trauma to the peritoneal tissues, minimise remaining suture material, avoid spillage of enteric contents, avoid tissue ischaemia, achieve haemostasis at operations and wiping off the starch on the surgical gloves together with laparoscopy(Di Saverio et al., 2013; Kuremu & Jumbi, 2006; Lawal et al., 2005).

Substances that try to reduce adhesion formation have not shown much success (Di Saverio et al., 2013; Jumbi, 2014; Khairy et al., 2005; Kuremu & Jumbi, 2006). Adhesions are reported to occur in about 95% of adults undergoing abdominal surgery(S.-C. Chen et al., 2005) but only 1-3% of these will eventually cause intestinal obstruction(Duron et al., 2008; Khairy et al., 2005; Menzies & Ellis, 1990).Other factors such as patient age of less than 60years and emergency surgery may also promote post-operative adhesions(Di Saverio et al., 2013). Laparoscopic surgery is associated with development of fewer adhesions as compared with open surgery due to reduced peritoneal trauma(Di Saverio et al., 2013; Hayanga et al., 2005) and its increasing use should be encouraged.

Overall, IO affects more men than women. However, some authors report slightly higher frequency of adhesive bowel obstruction in women attributing it to obstetric,

gynaecologic, and other pelvic surgical procedures which are important aetiologies for the development of postoperative adhesions(Ashley, 2007).

Qureshi et al found the commonest cause of intestinal obstruction to be obstructed inguinal hernia, followed by adhesions(Qureshi & Khan, 2008). This pattern is typical of developing countries. Some authors attribute this pattern to social taboos and lack of awareness in attending clinics for a painless swelling in the groin region (Hayanga et al., 2005; Qureshi & Khan, 2008; Ullah et al., 2011). This may however be changing(Lawal et al., 2005; Maglinte et al., 2001; Ullah et al., 2011) with such changes being linked to several factors which include change in lifestyle, especially diet, improved level of education, increased accessibility to and improvement in health care facilities(Oladele et al., 2008).

With more external hernias being electively repaired, adhesive intestinal obstruction has gradually emerged as the leading cause of mechanical intestinal obstruction in places where external hernias had hitherto been the most common (S.-C. Chen et al., 2005; Khan et al., 2014; Kuremu & Jumbi, 2006; Lawal et al., 2005; Lohn, Austin, & Winslet, 2000; Oladele et al., 2008; Ooko et al., 2015). However, some regions particularly in Africa and other under-developed areas still report hernia as the commonest cause of intestinal obstruction(Adesunkanmi, Agbakwuru, & Badmus, 2000; Ahmed et al., 2010; Chalya et al., 2014; Kadhim J. O. , 2011; Ntakiyiruta & Mukarugwiro, 2009; Qureshi & Khan, 2008; Souvik et al., 2010).

Bowel volvulus is a special form of intestinal obstruction resulting from twisting of a loop of bowel around the axis of its own mesentery(Demissie, 2001; Roggo & Ottinger, 1992). It is a rapidly strangulating condition whose recognition and treatment must be expedited for good outcome. In studies conducted in Kenya and elsewhere, sigmoid volvulus was the commonest cause of obstruction among adults (Khan, Ullah, Jan,

Naseer, & Ahmad, 2011; Muyembe & Suleman, 2000; Ooko et al., 2015). Indeed, sigmoid volvulus is an important cause of large bowel obstruction worldwide (Nuhu & Jah, 2010) and is the commonest site of bowel volvulus (Frazee, Mucha, Farnell, & van Heerden, 1988; G. Jumbi & Kuremu, 2008; Kisa, Ogwang, Okello, & Komagum, 2009; Roggo & Ottinger, 1992). The second commonest site of volvulus has been reported as the caecum with 10-20% of volvulus cases (Roggo & Ottinger, 1992).

Sigmoid volvulus has been shown to have a marked male preponderance in various studies (G. Jumbi & Kuremu, 2008; Nuhu & Jah, 2010). It is particularly common in parts of Africa, Asia, Eastern Europe and Brazil which have been collectively described as the "Sigmoid belt"(G. Jumbi & Kuremu, 2008). Its presentation is often acute but sub-acute presentation with recurrent abdominal distension and constipation can occur (Kisa et al., 2009).

Volvulus can also affect the small bowel, sometimes with catastrophic impact when a large segment of bowel is involved(Roggo & Ottinger,, 1992). In the small bowel, it is classified into either primary or secondary(Demissie, 2001; Frazee et al., 1988; Roggo & Ottinger,1992). Primary small bowel volvulus is more common and occurs without identifiable risk factors in an anatomically normal abdomen, commonly affecting children and young adults(Demissie, 2001; Frazee et al., 1988; Roggo & Ottinger,1992). Secondary small bowel volvulus occurs in the presence of a predisposing factor such as adhesions or congenital mid-gut malrotation (Demissie, 2001; Frazee et al., 1988; Roggo & Ottinger,, 1992). The prevalence of small bowel volvulus varies widely, being commonest in parts of Africa, the Middle East and the Indian subcontinent (Demissie, 2001; Frazee et al., 1988; Roggo & Ottinger, 1992). Small bowel volvulus presents a diagnostic challenge and misdiagnosis may occur (Demissie, 2001; Frazee et al., 1988).

Another important cause of intestinal obstruction is neoplasm, both benign and malignant. They affect the colon more commonly than the small bowel(Kahi & Rex, 2003). These tumours can be either primary (arising from the bowel) or secondary. They cause intestinal obstruction by various mechanisms such as malignant strictures, bowel compression and intussusception where they act as lead-points(Marinis et al., 2009; Ongom et al., 2014). Tumours are reportedly uncommon in many African settings(Jumbi, 2014; Muyembe & Suleman, 2000; Ntakiyiruta & Mukarugwiro, 2009; Ooko et al., 2015) but many studies in the developed and developing countries demonstrate tumours as a common cause of intestinal obstruction, especially colonic obstruction (Ahmed et al., 2010; Jackson & Raiji, 2011; Kadhim J. O. , 2011; Souvik et al., 2010; Ullah et al., 2011). They assume a particularly important place in regions like ours where delayed presentation among patients is common.

There are other relatively unusual causes of intestinal obstruction. These include necrotising enterocolitis(NEC) particularly in premature neonates(Kuremu, Hadley, & Wiersma, 2004), abdominal cocoons (Sclerosing Encapsulating Peritonitis, SEP) (Dwivedi, Gharde, & Johrapurkar, 2009),intramural hematomas within the bowel wall (in patients on warfarin) and bezoars(Kahi & Rex, 2003; Lohn et al., 2000). Bezoars are concretions found in the stomach or intestines. They usually arise in the stomach but when lodged in the intestines, mechanical bowel obstruction results(de Silva, Guyatt, & Bundy, 1997a).

In some cases, intestinal worms are the cause of bowel obstruction (Holcombe, 1995; Lugaria, 2008; Ogundoyin et al., 2009). Intestinal worms especially *Ascaris lumbricoides*(a nematode)have been known to cause intestinal obstruction (by congregation or rarely by causing bowel volvulus)especially in developing countries(de Silva et al., 1997a; de Silva, Guyatt, & Bundy, 1997b; Holcombe, 1995; Lugaria, 2008;

Ogundoyin et al., 2009; Roggo & Ottinger,1992). Indeed it has been reported that the most common acute complication of Ascaris infestation is intestinal obstruction with a significant mortality of 5-6% (de Silva et al., 1997a). The number of such worms must be in large number (excess of 60 worms) to cause obstruction and many more for fatal cases(de Silva et al., 1997b).Another nematode known to cause intestinal obstruction is *Strongyloides stercolaris* which unlike Ascaris is more common in the adult population than children (Lohn et al., 2000). It leads to intestinal obstruction by causing ileus of the bowel (Lohn et al., 2000).

Other uncommon causes of intestinal obstruction include endometriosis of the bowel and uterine fibroids(Lohn et al., 2000).Abdominal tuberculosis(TB) is also an important cause of stricture formation in the small bowel(Qureshi & Khan, 2008) and has been reported as the leading cause of intestinal obstruction in some areas (Khan et al., 2014).In patients with a localized intra-abdominal abscess such as in a ruptured appendix, features of intestinal obstruction may develop more likely due to intense local ileus (on the adjacent bowel) rather than mechanical pressure of the abscess(Hayanga et al., 2005).

The clinical presentation of intestinal obstruction varies with patients and also the level and degree of obstruction (Hayanga et al., 2005; Jackson & Raiji, 2011; Kahi & Rex, 2003). The integrity of gut vascular supply also determines the clinical presentation. The unifying feature is a contracted intra-vascular compartment (due to reduced intake, vomiting and sequestration of fluid in the bowel wall and lumen)(Hayanga et al., 2005)which leads to various physiologic derangements such as electrolyte imbalances, oliguria, renal failure and hemodynamic instability(Kahi & Rex, 2003).

The presence of bowel obstruction should be suspected in any patient presenting with abdominal pain, vomiting, distension, and obstipation(Di Saverio et al., 2013; Fischer et al., 2006; Kahi & Rex, 2003). These features may not be present in all patients and their severity varies. Distension may be mild or massive but is often absent with proximal bowel obstructions(Fischer et al., 2006). Patients with strangulation obstruction may have little vomiting or distension(Fischer et al., 2006).

2.4. Diagnosis

The diagnosis of intestinal obstruction can be difficult(Kadhim J. O. , 2011) and relies heavily on history taking and physical examination findings. The presentation may vary with age. In neonates, intestinal obstruction should be suspected if bilious vomiting occurs(Millar et al., 2000) even without other features considered classical for intestinal obstruction such as abdominal distension. Aspiration of >25ml of fluid from the stomach via a nasogastric tube(NGT) is very suggestive of intestinal obstruction even when physical findings are non-revealing (Millar et al., 2000).

The cardinal features of intestinal obstruction are vomiting, abdominal pain, abdominal distension and constipation(Asad et al., 2011; Hayanga et al., 2005; Jackson & Raiji, 2011; Qureshi & Khan, 2008; Ullah et al., 2011). Quresh et al found the commonest symptom as being pain followed by absolute constipation, with abdominal distension and vomiting being the last symptoms to appear. Tachycardia and abdominal tenderness were the common signs(Qureshi & Khan, 2008). However, the dominant features in a patient with intestinal obstruction largely depend on the level and degree of obstruction.

A patient may continue to pass stool even in the setting of intestinal obstruction such as would occur in partial obstruction or in complete obstruction where the contents distal to the level of obstruction continue being evacuated(Hayanga et al., 2005; Kahi & Rex,

2003). It may therefore be difficult to distinguish early complete obstruction from partial intestinal obstruction even though continued passage of stool/ flatus 6-12 hours after onset of illness is more in-keeping with partial obstruction (Hayanga et al., 2005).

The relationship between the onset of pain and the first episode of vomiting is a clue to how high the obstruction is and the frequency of the cramps is also somewhat indicative of the level of obstruction(Fischer et al., 2006).Bowel sounds are classically high-pitched and active, coming on in rushes coincident with crampy pain but become hypoactive as the disease progresses(Fischer et al., 2006; Kahi & Rex, 2003). Thin people may manifest visible peristalsis. Abdominal tenderness tends to be diffuse and mild in simple small bowel obstruction but may be localized to a single quadrant in strangulation obstruction(Fischer et al., 2006).The etiology can often be pinpointed by careful history-taking complemented with imaging studies(Ashley, 2007; Hayanga et al., 2005).

To make a diagnosis of intestinal obstruction, clinical findings (history and physical findings) may be all that is required. This is the case in such conditions as incarcerated inguinal hernia(Qureshi & Khan, 2008). Often, however, radiological investigations are required not only in assisting in diagnosis-making, but also in elucidating the cause and degree of obstruction. Some of these tests include plain abdominal x-ray, ultrasound and CT scan of the abdomen. Their specific indications vary based on the suspected cause of obstruction.

The essential diagnostic test in all such patients is four radiographic views of the abdomen: an upright chest, an upright abdomen, a supine abdomen, and a left lateral decubitus view(Fischer et al., 2006). However, two views in abdominal x-ray (supine and erect) are often sufficient(Di Saverio et al., 2013; Hayanga et al., 2005; Jackson &

Raiji, 2011; Kahi & Rex, 2003; Millar et al., 2000). The supine view is best for assessing the degree of bowel distension while an erect view helps in identification of air-fluid levels(Kahi & Rex, 2003).

Plain abdominal films can be diagnostic of intestinal obstruction in 50–80% of patients(Ashley, 2007; Hayanga et al., 2005; Jackson & Raiji, 2011). The x-ray findings in intestinal obstruction include multiple air-fluid levels, distended bowel loops and absence of gas in distal loops of bowel(Di Saverio et al., 2013; Hayanga et al., 2005). The presence of significant amounts of colonic gas should raise the suspicion of the presence of obstruction of the large bowel rather than the small bowel(Fischer et al., 2006).Other features on x-ray include free peritoneal gas and pneumatosis intestinalis (Kahi & Rex, 2003). These two features should prompt emergency surgery as they signify complications. All patients suspected of having intestinal obstruction should have plain abdominal x-ray done(Di Saverio et al., 2013; Kahi & Rex, 2003).A carefully performed history and physical examination, coupled with x-ray of the abdomen, is often sufficient(Carneiro & Kisusi, 2004; Fischer et al., 2006; Maglinte et al., 2001). However, a normal abdominal x-ray cannot rule out intestinal obstruction (Roggo & Ottinger,, 1992).

Although ultrasonography (US) has been disregarded by many clinicians, many authors have reported that in experienced hands, US is more sensitive and specific than plain abdominal films for the diagnosis of bowel obstruction (Ashley, 2007; Hayanga et al., 2005; Musoke, Kawooya, & Kiguli-Malwadde, 2003). Its sensitivity in complete obstruction approaches 85% and is particularly useful when radiation is contra-indicated such as in pregnancy(Jackson & Raiji, 2011).The proponents of use of ultrasound for diagnosing intestinal obstruction note that plain x-ray (while accurate in diagnosis of

intestinal obstruction) rarely detects the cause of intestinal obstruction and cannot assess strangulation(Musoke et al., 2003).

Common causes of intestinal obstruction like adhesions can be diagnosed indirectly by use of ultrasound criteria but the same cannot be said of plain abdominal x-ray(Musoke et al., 2003). The findings that suggest intestinal obstruction include distended bowel loops, increased peristalsis, difference in mucosal folds around the transitional point and free peritoneal fluid suggestive of ischemia(Di Saverio et al., 2013).It is especially useful for antenatal diagnosis of intestinal obstruction. This may be demonstrated by dilated bowel loops with vigorous peristalsis and in some cases polyhydramnios (Millar et al., 2000).Unfortunately, intestinal atresia in Africa is not usually diagnosed antenatally(Millar et al., 2000).

However, the US is heavily operator-dependent and therefore its usefulness is varied. In addition, its usefulness is limited with gaseous distension of the bowel loop which hinders vision of underlying structures(Di Saverio et al., 2013) though some authors disagree with this (Musoke et al., 2003). Ultrasound machines and trained personnel are now widely available in many parts of Africa and the same authors (Musoke et al., 2003) recommend its use as the primary investigation of choice in intestinal obstruction, with x-ray playing a complimentary role.

Abdominal CT scan with contrast is of value especially when the clinical findings and plain abdominal x-ray are atypical, inconclusive or confusing (Di Saverio et al., 2013; Hayanga et al., 2005; Kahi & Rex, 2003). This may be in as many as 20-30% of the patients(Kahi & Rex, 2003). Sometimes, the diagnosis of small bowel obstruction will be obscure and a CT scan with oral contrast may prove diagnostic (Ameh & Chirdan, 2000; Fischer et al., 2006; Jackson & Raiji, 2011). Such cases include patients with adult

intussusception where CT scan is considered the most sensitive tool with an accuracy of 58-100%(Marinis et al., 2009).

However, CT scan should not be recommended for all patients suspected to have intestinal obstruction and should therefore not be routinely done during evaluation of patients suspected of having intestinal obstruction (Di Saverio et al., 2013).It may allow precise determination of the aetiology and site of obstruction(Di Saverio et al., 2013).It is also useful in assessing bowel strangulation and has been reported to have sensitivity and specificity of more than 90% and a negative predictive value (NPV) of nearly 100%(Di Saverio et al., 2013; Jackson & Raiji, 2011; Kahi & Rex, 2003; Maglinte et al., 2001). Its sensitivity and specificity is however lower in partial intestinal obstruction and in such situations, enteroclysis or CT-enteroclysis are of value(Maglinte et al., 2001). Some authors have recommended the use of CT-enteroclysis as the primary investigation in patients with prior history of abdominal malignancy or Crohn's disease presenting with intestinal obstruction (Maglinte et al., 2001).

The utility of upper gastrointestinal contrast studies is controversial, and some authors have discouraged their use (Fischer et al., 2006). Water soluble contrast follow-through may however be used in patients on conservative management to rule out complete obstruction and predict the need for surgery(S.-C. Chen et al., 2005; Di Saverio et al., 2013; Hayanga et al., 2005; Jackson & Raiji, 2011; Kahi & Rex, 2003; Maglinte et al., 2001; Qureshi & Khan, 2008). They can indeed be therapeutic in adhesive small bowel obstruction and the presence of contrast in the colon on abdominal x-ray within 24 hours of its administration predicts resolution(Di Saverio et al., 2013; Jackson & Raiji, 2011) with a sensitivity of 96% and specificity of 98% (X.-L. Chen et al., 2012). Contrast studies are also useful in making the diagnosis of intestinal obstruction in neonates (Ameh & Chirdan, 2000) and intussusception at all ages (Kuremu, 2004; Marinis et al.,

2009). Adult intussusception is correctly diagnosed pre-operatively in 40-50% of cases(Marinis et al., 2009) signifying the difficulties in making such a diagnosis.

Magnetic resonance imaging is restricted to patients with contraindication to CT scan or iodine contrast and may be more sensitive (Di Saverio et al., 2013; Hayanga et al., 2005; Jackson & Raiji, 2011).Diagnostic endoscopy is also useful in scenarios such as sub-acute and chronic large bowel obstruction where identification of the cause of intestinal obstruction and/or the presence of a “lead-point” can be noted(Marinis et al., 2009).

Other diagnoses such as chronic intestinal pseudo-obstruction are best made by exclusion but suspicion should be high in patients with persistent obstructive features after Ladd’s procedure for mid-gut malrotation or when there are features of bladder dysmotility or recurrent intestinal obstruction (Heneyke et al., 1999).

Other tests conducted in patients suspected to have intestinal obstruction include laboratory tests which are, however, nonspecific. Their findings include leucocytosis with shift to the left, elevated hematocrit, electrolyte abnormalities, raised blood urea nitrogen and metabolic alkalosis due to vomiting(Hayanga et al., 2005; Kahi & Rex, 2003). Presence of lactic acidosis, hyperkalemia and elevated serum amylase or lipase may signify bowel ischemia. However, like clinical and radiological findings, none of these parameter can accurately distinguish simple from strangulating intestinal obstruction (Kahi & Rex, 2003).

2.5. Treatment

For successful management of patients with intestinal obstruction, early recognition and aggressive treatment in patients of all ages, especially neonates, can prevent irreversible ischemia and trans-mural necrosis, thereby decreasing mortality and long-term morbidity(Ashley, 2007; Qureshi & Khan, 2008). Treatment involves correction of

physiologic derangements, bowel rest and relieving the cause of obstruction(Jackson & Raiji, 2011).

Once the diagnosis of bowel obstruction has been made, the most important initial step is to rehydrate the patient and restore the normal electrolyte and acid/base balance (Fischer et al., 2006; Heneyke et al., 1999). In a study conducted by Kuremu R.T. (Kuremu, 2004)on childhood intussusception, majority of the patients were dehydrated at the time of presentation to a tertiary health facility despite many having been referred from other health facilities. Isotonic intravenous fluid should be used for resuscitation(Carcillo & Tasker, 2006; Kahi & Rex, 2003). Fluid resuscitation must be time-sensitive and has the greatest effect when administration begins at the community hospital before referral(Carcillo & Tasker, 2006). Aggressive electrolyte correction should only follow confirmation of adequate kidney function(Jackson & Raiji, 2011).

Adults who are clinically dehydrated require about 4 litres of fluid, while those who are hypotensive from reduction of extracellular volume may need up to 6-8L(Holcombe, 1995; Waxman, 1998). Nearly all this should be given as normal saline or Hartmann's solution(Waxman, 1998). Colloid solutions such as 5% albumin or hetastarch have little or no role in the resuscitation of patients with bowel obstruction(Ashley, 2007).

A normal volume and electrolyte balance must be continued through to post-operative period. Inadequate post-operative intravenous fluid therapy has significant association with adverse outcome(G. Jumbi & Kuremu, 2008). In our setting, adequate fluid therapy is often a challenge with fluid charts being poorly kept and inadequate amounts of fluid being given(Kuremu & Jumbi, 2006).

Management must also involve gut decompression via nasogastric or long tube which relieves intra-luminal pressure and prevents aspiration (X.-L. Chen et al., 2012; Millar et

al., 2000). Some authors did not demonstrate any advantage of the long tube over nasogastric tube (short tube) and its use is currently limited in many regions (Di Saverio et al., 2013; Hayanga et al., 2005; Kahi & Rex, 2003). However, other authors reported a significant difference between the NGT and a relatively new (introduced in 2003) long tube called hydrophilic silicon triple-lumen ileus tube(X.-L. Chen et al., 2012). This study demonstrated greater success in bowel decompression and resolution of intestinal obstruction in patients using this particular tube as compared with the normal NGT(X.-L. Chen et al., 2012).

Other authors have also demonstrated the superiority of similar long tubes over the short NGT and described it as the optimal mode of bowel decompression (Maglinte et al., 2001). The decompression tube (regardless of type) must be actively managed with serial suctioning for it to be effective(Hayanga et al., 2005; Kuremu & Jumbi, 2006).These steps are the same for all patients, whether they will be managed operatively or undergo a trial of non-operative management(Ashley, 2007).

An indwelling Foley catheter is mandatory, as the production of a satisfactory volume of urine is the most useful sign of successful volume resuscitation, and urine output must commence prior to induction of general anaesthesia(Fischer et al., 2006; Hayanga et al., 2005; Jackson & Raiji, 2011; Kuremu, 2004; Millar et al., 2000). This satisfactory urine production is a volume of 0.5-1ml of urine for every kilogram body weight per hour. Other ways of monitoring the adequacy of fluid resuscitation are invasive central venous pressure or arterial canalization for monitoring(Hayanga et al., 2005; Jackson & Raiji, 2011). These should however be used in the very sick patient and not routinely.

The use of antibiotics in intestinal obstruction patients, like in many areas in surgery, is somewhat controversial(Fischer et al., 2006). However, any patient who develops fever or leucocytosis (Jackson & Raiji, 2011) or one who is being prepared for operation

should receive peri-operative antibiotics. Some authors however recommend antibiotics for all patients with intestinal obstruction (Hayanga et al., 2005).

Any drug regimen effective against the more common Gram-positive and Gram-negative aerobic and anaerobic bacteria is sufficient (Fischer et al., 2006; Hayanga et al., 2005; Jackson & Raiji, 2011). Specific drugs should be guided by local susceptibility and availability(Jackson & Raiji, 2011). Notable is the fact that faecal flora proliferate in direct proportion to duration of obstruction, reaching a plateau of 10^9–10^{10} colonies/ml after 12–48 hours of an established obstruction(Ashley, 2007). Indeed, bacterial translocation across the defective mucosal barrier has been demonstrated even before manual manipulation of the bowel(Ezer et al., 2012). Antibiotics limit the bacterial overgrowth and their translocation across the bowel wall(Jackson & Raiji, 2011)and this may justify their use in all patients with intestinal obstruction.

The definitive treatment of patients with intestinal obstruction can be either operative or non-operative (conservative). The risk of surgery must therefore be weighed against the consequences of inappropriate non-operative management(Jackson & Raiji, 2011). However, some patients may need operative management after a period of unsuccessful conservative treatment and the indications and length of conservative management as well as the timing of surgery when indicated can be a difficult issue(Di Saverio et al., 2013; Kahi & Rex, 2003).

Management options for small bowel obstruction (SBO) due to causes, other than obstructed hernia, should be evaluated as complete or partial (Qureshi & Khan, 2008). Conservative management involves proximal decompression with NGT, bowel rest, water and electrolyte replacement and repeated (4-6 hourly) evaluation of the clinical

state- abdominal girth, development of tenderness, changes in bowel sounds and cardiovascular status(S.-C. Chen et al., 2005; Henry & Thompson, 2001).

The indications for non-operative management include firm evidence that there is not a threat to the viability of the bowel and incomplete obstruction in either small or large bowel with features which suggest non-progression (Hayanga et al., 2005; Henry & Thompson, 2001; Kahi & Rex, 2003). Patients with an incomplete small bowel obstruction and no evidence of ischemic bowel may be safely treated conservatively for some time because resolution may be expected in up to 80% of this group(Fischer et al., 2006). Only patients with uncomplicated bowel obstruction should be considered for a trial of non-operative management(Ashley, 2007).

Indeed, conservative management has been shown to reduce the length of hospital stay together with avoiding worsening of the adhesions that would occur with repeated surgery(X.-L. Chen et al., 2012; Di Saverio et al., 2013).The disadvantage of conservative management is that it does not eliminate the cause of obstruction and is associated with higher recurrence and re-admission rates(Di Saverio et al., 2013). In addition, while offering conservative treatment, it must be kept in mind that delay in surgery may substantially increase the morbidity and mortality rate(Di Saverio et al., 2013).In the management of obstructed hernia early operative treatment is recommended as delay can lead to strangulation(Adesunkanmi et al., 2000; Hayanga et al., 2005; Qureshi & Khan, 2008).

Contraindications to non-operative management include suspected ischemia, large bowel obstruction, closed-loop obstruction, strangulated hernia, and perforation or peritonitis (Ashley, 2007; X.-L. Chen et al., 2012; Di Saverio et al., 2013; Kahi & Rex, 2003). Some authors have recommended surgery in patients with persistent vomiting or

drainage volume of >500ml through the long tube on day 3(X.-L. Chen et al., 2012; Di Saverio et al., 2013). A relative contraindication to non-operative management is complete small bowel obstruction which is reliably indicated by obstipation (Ashley, 2007; Kahi & Rex, 2003) and early surgery has been treatment of choice for patients in whom complete obstruction is the diagnosis due to the higher risk of strangulation (20-40%) and less chance of spontaneous resolution (Hayanga et al., 2005; Qureshi & Khan, 2008). Indeed, complete SBO (no air within large intestines) is said to predict failure in conservative management(Di Saverio et al., 2013).Most of the patients who are successfully treated non-operatively show definite signs of clinical improvement within 24 hours, and nearly all by 48 hours(Fischer et al., 2006; Jackson & Raiji, 2011).

Intestinal ischemia is difficult to diagnose clinically (Adesunkanmi et al., 2000; Di Saverio et al., 2013). A number of clinical and laboratory parameters have been used in an attempt to predict progression of obstruction to the point of strangulation. Fever, tachycardia, leucocytosis and localised tenderness have most commonly been cited as indictors of a higher risk of strangulation (Carneiro & Kisusi, 2004; Di Saverio et al., 2013; Hayanga et al., 2005; Jackson & Raiji, 2011; Kadhim J. O. , 2011; Kahi & Rex, 2003; Mellinger, 2006; Stewardson et al., 1978). A patient with features of systemic toxicity should raise suspicion for strangulation (Kahi & Rex, 2003). None of these (alone or in combination) is specific or accurate in diagnosing strangulating obstruction even in experienced hands (Di Saverio et al., 2013; Hayanga et al., 2005; Roggo & Ottinger, 1992; Stewardson et al., 1978).In one study the risk of strangulation was shown to increase from 7% when one of these signs is present to 67% when all four are noted(Mellinger, 2006).

In a study on intussusception in infants conducted by Carneiro et al, all infants with fever revealed gangrenous intussusceptum intra-operatively (Carneiro & Kisusi, 2004).

Other indicators of possible strangulation or perforation include signs of hypovolemia, systemic inflammatory response and peritoneal irritation (Henry & Thompson, 2001; Jackson & Raiji, 2011). There are no accurate investigations to help diagnose bowel strangulation, which is a clinical diagnosis best confirmed at laparotomy (Burkitt, 2002; Hayanga et al., 2005).

A limit of 5 days or less is usually placed on conservative management but special circumstances may alter this in either direction (Di Saverio et al., 2013; Hayanga et al., 2005; Henry & Thompson, 2001). The risk of infarction also appears to rise in patients with high grade (complete) obstruction who are managed non-operatively for more than 24 to 48 hours(S.-C. Chen et al., 2005; Jackson & Raiji, 2011; Mellinger, 2006; Qureshi & Khan, 2008). Accordingly some authors recommend that this should be the maximum period of observation and after 48 hours, laparotomy is indicated (X.-L. Chen et al., 2012; Fischer et al., 2006).

However, longer periods of observation and conservative nonsurgical management may be appropriate in situations like early post-operative obstructions(Mellinger, 2006). The majority of these may resolve within two weeks as acute, bulky adhesions and associated postoperative bowel oedema begin to mature and resolve respectively(Mellinger, 2006).A special sub-group are patients who develop early post-operative small bowel obstruction with obliterative peritonitis (“frozen abdomen”). This condition is caused by dense, vascular and inseparable inflammatory adhesions in response to multiple sequential laparotomies, surgery for enterocutaneous fistula or extensive adhesiolysis(Gong, Zhu, Yu, Li, & Li, 2013). Such patients are at high risk for iatrogenic injuries during surgery and non-operative management with parenteral nutrition may take weeks or even months (Gong et al., 2013).

With close monitoring and absence of signs suggestive of complications, an observation of even more than 10 days with inclusion of total parenteral nutrition (TPN) in their care may be safe(Di Saverio et al., 2013). Such management may be pursued in patients with repeated episodes of intestinal obstruction and many prior laparotomies for adhesions in an attempt to avoid complex and high-risk procedures (Di Saverio et al., 2013).

However, even in the aforementioned subset of patients, onset of fever and leucocytosis (>15,000/mm^3) predict intestinal complications and conservative management should be abandoned(Di Saverio et al., 2013). It must though be borne in mind at all times that some studies have shown increased complication rate, need for bowel resection, prolonged length of hospital stay and death in patients who are on conservative management for more than 3 days (Di Saverio et al., 2013).

There is also need to consider the duration between onset of illness and presentation to hospital while considering how long conservative management should last(Kuremu & Jumbi, 2006). Indeed, delayed presentation to hospital has been shown to be associated with higher failure rates of non-operative management (X.-L. Chen et al., 2012).

The rate of success is likely influenced by patient selection, type of bowel obstruction (complete versus partial, or recurrent, among others), etiology (e.g., adhesions, hernia, or neoplasm), the surgeon's threshold for conversion to operative management, and practice differences related to suspected ischemia (Ashley, 2007). If the obstruction is partial or low grade and there is a history of abdominal surgery with no palpable hernia, the obstruction is likely adhesive in nature, with an approximate 80% chance of resolution with conservative management(Fischer et al., 2006; Hayanga et al., 2005; Henry & Thompson, 2001).Many studies have reported success in conservative management of between 60-80%(S.-C. Chen et al., 2005; Jackson & Raiji, 2011; Malik et al., 2010).

However other authors report much less success with figures as low as 15%(Lawal et al., 2005).

The use of gastrograffin in adhesive SBO is safe and has been shown to reduce the need for surgery and the time to resolution as well as reducing the length of hospital stay(Di Saverio et al., 2013; Hayanga et al., 2005). It is administered at a dose of 50-150ml orally or via NGT either at admission or after 48 hours of conservative management(Di Saverio et al., 2013). In addition, oral therapy with magnesium oxide, *Lactobacillus acidophilus* and simethicone may hasten resolution of partial adhesive intestinal obstruction and reduce the length of hospital stay(S.-C. Chen et al., 2005; Di Saverio et al., 2013; Jackson & Raiji, 2011).Magnesium oxide increases peristalsis, *L. acidophilus* helps to digest remaining undigested food debris and simethicone, being a defoaming agent, helps gas bubbles coalesce and pass easily (S.-C. Chen et al., 2005; Di Saverio et al., 2013; Jackson & Raiji, 2011).

Individuals who have no prior surgery or externally demonstrable hernia on which to blame the obstruction should be prepared for surgery, provided the diagnosis seems clear, since a high percentage of such patients will have conditions that will require operative management(Mellinger, 2006). Patients with complete obstruction or with high risk of strangulation should generally be prepared for prompt surgical intervention, since in this setting, the likelihood of resolution is diminished and the risk of bowel ischemia heightened(Mellinger, 2006). When strangulation is diagnosed or even suspected, operation must be performed urgently (after rapid fluid resuscitation) to try prevent infarction and perforation(Burkitt, 2002). Late presentation and older age require early surgical intervention to decrease chance of strangulation leading to high post-operative morbidity(Qureshi & Khan, 2008).

Open surgery is usually recommended for strangulating obstruction but laparoscopic adhesiolysis should be attempted in cases of first time adhesive SBO, in patients who have had less than three prior abdominal surgeries or anticipated single band adhesion (i.e. SBO after appendectomy or hysterectomy) (Di Saverio et al., 2013; Hayanga et al., 2005).The success rate for laparoscopic adhesiolysis has been reported as 68%(Hayanga et al., 2005). A low threshold for open conversion should be maintained if dense adhesions are encountered(Di Saverio et al., 2013). Laparoscopic-assisted adhesiolysis (mini-laparotomy with an incision less than four centimetres long) or laparotomy should be considered in dense or pelvic adhesion(Di Saverio et al., 2013).

There may be not enough time for adequate resuscitation and the benefits of delaying operation to allow resuscitation must be balanced against the risk of progressive impairment of the blood supply to the obstructed bowel. The decision when best to operate may thus be difficult(Forrest, 1991; Kadhim J. O. , 2011). Important though is the realisation that operation may be the resuscitation required.

There is also a role for interventional colonoscopy in carefully selected patients. It may help in avoiding unnecessary surgery such as in patients with pseudo-obstruction which mainly affects the colon(Kahi & Rex, 2003; Katsanos et al., 2010). Its use has been demonstrated in colonic tumours and in selected elderly patients either alone or in combination with surgery (Katsanos et al., 2010). In sigmoid volvulus, proctosigmoidoscopic reduction may be performed followed by semi-elective surgery during the same admission(Kahi & Rex, 2003). There are reports of good success rates with endoscopic reduction (60-95%) but with an attendant high recurrence rate of 40-60%(Kahi & Rex, 2003). Notable also is the fact that endoscopic assessment of bowel ischemia is often inaccurate in predicting the depth (in the colonic wall) of the ischemic injury and therefore this practice has not been firmly established(Kahi & Rex, 2003). In

patients with acute colonic pseudo-obstruction (acute colonic ileus, Ogilvie's syndrome), colonoscopy, for failed non-operative management and pharmacologic treatment with neostigmine, is successful in 70% of cases but with recurrences of 40%(Kahi & Rex, 2003).

Infants with ultra-short bowel resulting from atresia may be managed conservatively in resource-limited settings without parenteral nutrition support or neonatal ICU care(Millar et al., 2000). In such situations, withdrawal of treatment that is thought to be futile is often difficult to institute(Millar et al., 2000).

2.6. Prognosis

The outcomes of intestinal obstruction vary widely. This can be evaluated through morbidity and mortality rates and the duration of hospital stay. These outcomes are influenced by many patient factors and presence or absence of both medical and surgical postoperative complications. Many authors observed that late presentation accounted for the high rate of bowel resection and mortality (Bhuiyan, Machowski, Linyama, & Modiba, 2005; Carneiro & Kisusi, 2004; Chalya et al., 2014; Demissie, 2001; Lawal et al., 2005; Millar et al., 2000; Oladele et al., 2008).

In a study conducted by Kuremu R. T. (Kuremu, 2004)the unfavourable outcomes were also attributed to delayed presentation for surgical intervention and poor peri-operative care. The delay before presentation is attributable to low socio-economic status, limited hospital facilities, poor means of transport, unequal distribution of expertise and lower doctor-patient ratio(Bhuiyan et al., 2005; Kuremu, 2004; Kuremu & Jumbi, 2006). Presence of gangrene is associated with higher morbidity and mortality rate and duration of hospital stay(Adesunkanmi et al., 2000; Kahi & Rex, 2003; Lawal et al., 2005; Oladele et al., 2008; Ooko et al., 2015).

Medical complications that may follow management of patients with intestinal obstruction include cardiac, pulmonary, urinary and deep venous thrombosis (DVT). Surgical complications such as wound sepsis, peritonitis and abscess formation, gut necrosis, persistent ileus, fistula formation among others may also occur.

Postoperative ileus represents the most common cause of delayed hospital discharge after abdominal operations. The duration of postoperative ileus tends to correlate with the degree of surgical trauma as well as the type of operation, and might even be considered a "physiologic" response (Ashley, 2007). However, the small bowel generally recovers effective motor function within several hours after the operation(Ashley, 2007) and prolonged (>72hours) ileus is abnormal and the cause must be sought.

The mortality rate in mechanical intestinal obstruction is influenced by many factors, principally age, etiology, site and duration of obstruction and especially whether or not gangrene has occurred (Ahmed et al., 2010; Carneiro & Kisusi, 2004; Demissie, 2001; "Handbook of surgery ", 1973; Hayanga et al., 2005; Lawal et al., 2005; Millar et al., 2000; Stewardson et al., 1978; Tumusiime et al., 2009). To illustrate this, neonatal intestinal atresia has survival of >90% in developed countries but only about 40-50% in Africa where patients present late and resources are limited(Ahmed et al., 2010; Ameh & Chirdan, 2000; Millar et al., 2000).

The longer the duration of obstruction, the higher the death rate(Carneiro & Kisusi, 2004; "Handbook of surgery ", 1973) as has clearly been demonstrated by the mortality in patients with intussusception which depends entirely upon the interval between the onset of symptoms and operation(Cotton, 1986). Quresh et al (Qureshi & Khan, 2008)observed that in patients operated late for SBO, the rate of gut strangulation,

complications and death is high. Within the first 12 hours, operative treatment should not be followed by any complication(Cotton, 1986).

The mortality rate from simple obstruction has decreased as a result of improved fluid therapy, emphasis on early operation and antibiotics (Wilson, 1973). While studying fluid resuscitation in children, Carcillo et al (Carcillo & Tasker, 2006)demonstrated that mortality rate from diseases associated with hypovolemic shock (including intestinal obstruction) decreased more than tenfold with adequate fluid therapy.

The overall mortality and morbidity of bowel obstruction is substantial. Mortality rates range from up to 3% for simple obstructions to as much as 30% when there is vascular compromise or perforation of the obstructed bowel, depending on the clinical setting and other related or unrelated co-morbidities (Ashley, 2007; Demissie, 2001). Jumbi et al found low mortality in the absence of high risk factors such as advanced age, cardiovascular disease and neuro-psychiatric disease (low co-morbidity rate) in patients undergoing emergency resection of sigmoid volvulus (Jumbi & Kuremu, 2008).

In another study, mortality was less than 1% for laparotomy in the setting of uncomplicated small bowel obstruction (SBO) but in excess of 25% when strangulation has occurred(Mellinger, 2006). In a study conducted in Nigeria by Oladele et al (Oladele et al., 2008),the overall mortality was 20%, while a mortality rate of 4.5% was reported in another study conducted in Tenwek Hospital in Bomet, Kenya (Ooko et al., 2015). The reasons for high mortality in some of these studies were attributed to delayed presentation, fluid and electrolyte imbalance, intestinal ischemia and gangrene with septic complications (Lawal et al., 2005; Malik et al., 2010; Oladele et al., 2008). Resection of strangulated bowel in infants carries high mortality (Cotton, 1986).

Future intestinal obstruction will recur in about 12% of patients after primary conservative treatment and in between 8% and 32% of patients after operative management for adhesive bowel obstruction(Ashley, 2007; Jackson & Raiji, 2011).

CHAPTER THREE: METHODOLOGY

3.1 Study area

This study was carried out at the MTRH in Eldoret, Kenya, which is located in Uasin Gishu County, in the North Rift region of Western Kenya. This is about 310 kilometers Northwest of Nairobi, the capital city of Kenya. The study was conducted at the accident/ emergency and inpatient departments of the hospital including the wards where these patients were admitted. The MTRH hospital is the second largest referral hospital in Kenya. It serves the greater western Kenya region representing about 40% (approximately 16.2 million people) of the country's population. It also serves Eastern Uganda and parts of Southern Sudan.

3.2 Study design

This was a hospital-based prospective study. Patients admitted with a diagnosis of intestinal obstruction were followed for the duration of their admission and their management and outcomes determined.

3.3 Study population

This included patients of all ages admitted with a diagnosis of intestinal obstruction at the MTRH between 15th September 2013 and 15th December 2014 who met the selection criteria and gave informed consent to participate in the study. The patients were identified and recruited at the point of admission or in the wards based on the presence of the cardinal features of intestinal obstruction with or without radiological investigations.

3.4 Subject selection

3.4.1 Inclusion criteria:

All patients admitted with a diagnosis of intestinal obstruction at the MTRH during the course of the study.

3.4.2 Exclusion criteria:

1. All patients with intestinal obstruction who had been operated on in other hospitals and referred to MTRH for further care

2. Patients who declined to give consent (and/or assent for children ≥7 yrs)

3.5 Sampling method

Participants were selected and enrolled consecutively as they presented to hospital for admission.

3.6 Sample size determination

A total of **199** subjects were identified in the course of the study and all were included for completeness. However, in order to determine the minimum sample size required to determine the actual pattern of intestinal obstruction and the representative outcomes at the MTRH, a sample size was determined by the use of Fisher *et al* statistical formula as follows:

$$n = \frac{Z^2pq}{d^2}$$

where:

n = desired sample size (when population is greater than 10,000)

Z = The standard normal deviate set at 1.96 which correspond to 95% confidence level.

p = Characteristic of the study population; in this case morbidity and mortality rates (12% from previous data at MTRH).

q = 1 – p (in this case q=1.0-0.12)

d = the degree of accuracy desired, which is here set at 5% or 0.05 corresponding to the 1.96

Therefore in substitution:

$$= \frac{(1.96)^2 \times 0.12 \times 0.88}{(0.05)^2}$$

= 162.27 Rounded to 163 participants

Adjusting for non-response by 15% gave sample size of **192** participants. Since the number of study participants exceeded the minimum sample required, the results were considered representative.

3.7 Data collection, Handling, Analysis and presentation

3.7.1 Data collection and Handling

Participants of the study were enrolled at the time the diagnosis of intestinal obstruction was confirmed by the researcher. This was either at admission or in the course of the patient's hospital stay for those patients in whom the diagnosis was reached after their admission. These patients were identified by the investigator during daily ward rounds and/or patient reviews. Data was collected using structured interviewer-administered questionnaires. The questionnaires were filled in the course of the patients' hospital stay starting at admission. For the acutely ill patients who could not give consent at admission, a third party (adult relative/ guardian) was asked to give consent on behalf of

the patient. The data collected included patient/ guardian's responses together with medical information recorded in the patient's file. Further information was acquired through physical examination of the patient and review of radiological investigations by the researcher. Any complication that arose was noted and recorded in the questionnaire as the patient was being followed up for length of their hospital stay. The questionnaires were duly filled once the eventual outcome was determined at either discharge or upon death of the participant. Any participant whose diagnosis changed from the initial diagnosis of intestinal obstruction to a different diagnosis was not included in the final tally of intestinal obstruction cases studied. All filled questionnaires were checked for completeness and coded accordingly. The data was entered in MS Access at the end of each day for storage and backup.

3.7.2 Data analysis and presentation

3.7.2.1. Descriptive statistics

Continuous data was analysed using means and median.

Categorical data was presented in the form of frequency tables and charts.

3.7.2.2 Inferential statistics

For continuous data, Student t- test (independent sample) was used to compare means between binary variables while Chi-square test and Fisher's Exact test were used for analysis of categorical data.

Logistic regression was used to control for confounders.

All data analysis was performed at 95% level of significance (p-value < 0.05).

3.7.2.3 Data presentation and dissemination

The data was presented in the form of charts, tables and graphs and the results presented to Moi University School of medicine and also to the MTRH board.

3.8 Measures of outcome

The outcomes of participants were assessed using morbidity rates, mortality rates and duration of their hospital stay. For the purpose of this study, the duration of hospital stay was the interval between the time of admission and the time a decision to discharge the patient was reached. Further stay in the ward for other reasons was not considered.

3.9. Ethical considerations

1. Informed consent to conduct the study was sought in writing:
    - Directly from adult patients (above 18yrs)
    - From an adult guardian/parent for patients below 18 years of age together with assent from all children older than 7 years of age.
2. No added cost on investigation or otherwise was added to the patients' bill.
3. Information gathered was confidential and used only for the purpose of this study
4. No patient names or other identifying characteristics were used in the course of the study; instead, patient hospital numbers and initials were used.
5. All participants were free to withdraw from the study at any point in time as they wished and without need to seek prior authorization to do so and without any consequences whatsoever for so doing.
6. Before initiation of this study, its proposal was submitted for scrutiny and approval by Institutional Research and Ethics Committee of Moi University and conditions complied with before the study commenced (approval number IREC 0001052).

3.10. Limitations of the study

Surgeries were performed by surgeons of different qualifications and experiences and therefore not standardized. However, all surgeons were considered to have adequate skills and ability to perform the different operations. This study was also constrained by time since it had to be completed within the stipulated period of the Masters programme. Further, the patients were only followed for the duration of their hospital stay and therefore long-term outcomes were not assessed. However, immediate outcomes for a largely acute condition like intestinal obstruction were thought to matter the most.

CHAPTER FOUR: RESULTS

4.1. Preliminary

4.1.1. Demographics

The demographic factors that were included in this study were age and sex. The age of the patients ranged from 1day to 86 years old, with a median of 22years (mean of 25.8 ±24.7). Children constituted 80 (40.2%) of the study subjects. Due to the wide standard deviation in the mean, the median was hence used for further data analysis. The male to female ratio was 1.4:1. Table 1 illustrates the demographic features of the study subjects.

Table1. Demographics of the study subjects

Age group	Male N(%)	Female N(%)	Total (%)
0-9	50 (64.9)	27 (35.1)	77 (38.7)
10-19	10 (62.5)	6 (37.5)	16 (8.0)
20-29	14 (53.8)	12 (46.2)	26 (13.1)
30-39	10 (55.6)	8 (44.4)	18 (9.0)
40-49	12 (70.6)	5 (29.4)	17 (8.5)
50-59	8 (40.0)	12 (60.0)	20 (10.0)
60-69	8 (61.5)	5 (38.5)	13 (6.5)
70-79	6 (60.0)	4 (40.0)	10 (5.0)
80-89	0 (0)	2 (100)	2 (1.0)
Total	118 (59.3)	81 (40.7)	199 (100)

From the table above, the age group 0-9 years had the most patients (77patients, 38.7%) followed by age bracket of 20-29 years (26 patients, 13.1%). The group with the least number of patients was 80-89 having only 2 (1%) patients.

4.1.2. Co-morbidity

Fifty eight co-morbidities were encountered among 40 patients (20%) as shown in table 2 below:

Table2. Co-morbidities in the study subjects

Co-morbidity	Frequency (%)
Hypertension (HTN)	9 (22.5)
Cardiac Disease	9 (22.5)
Human Immunodeficiency Virus infection (HIV)	6 (15)
Renal Failure	4 (19)
Prematurity	3 (7.5)
Malnutrition/Failure to thrive (FTT)	3 (7.5)
Pneumonia	2 (5)
Neonatal Sepsis	2 (5)
Others*	20 (50)

* Spina Bifida, Hydrocephalus, Congenital talipes equinovarus (CTEV), Neonatal Jaundice, Edward's Syndrome and Ovarian cancer in 2 patients (5%) each while Diabetes mellitus (DM), Burns, Cerebral Vascular accident (CVA), Intra-abdominal Malignancy, Undescended testis, Spinal Tuberculosis, Systemic Lupus Erythematosus (SLE) and Psychosis in 1patient (2.5%) each.

From the above table, chronic diseases such as hypertension, cardiac disease and HIV infection were the commonest co-morbid conditions among the study subjects. Diabetes

mellitus was uncommon and so were acute infective conditions like pneumonia and neonatal sepsis.

4.1.3. ASA classification

American Society of Anaesthesiologists (ASA) classification was done by the anaesthesia team involved in the management of these patients. This was only done in patients scheduled to undergo operation and therefore all patients under conservative management were not ASA-classified.

More than half (52.3%) of the patients were classified as ASA II which composed of 47% emergency cases and 5.4% “elective” cases. This was followed by ASA I that constituted 30.9% (24.8% Emergency & 6% “elective”) while class IV had the least number of patients at 2.7% (2% “elective”& 0.7% Emergency) of the patients as depicted in figure 1 below. The “elective” cases were patients who presented sub-acutely or chronically and were therefore prepared and subsequently operated semi-electively.

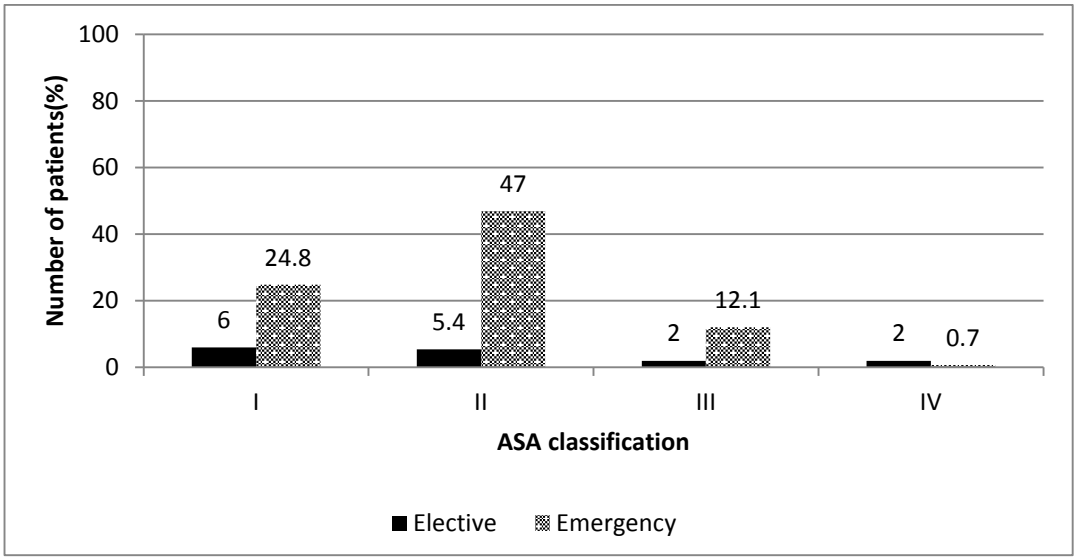

Figure 1: ASA classification

4.1.4. Duration of illness and Referral status

Majority (84.3%) of the patients presented to hospital more than 24 hours after the onset of symptoms. Many (93 patients, 46.7%) of the patients studied had an acute presentation (less than 4 days) with a mean duration of illness of 2.03±0.9 days. Seventy six patients (38.2%) had a sub-acute presentation (4 to 14 days) with a mean of 6.64±3 days. The remaining patients had a chronic presentation with a median duration of illness of 225 days (IQR=423.7). This latter category was exemplified by a patient who presented with Hirschsprung's disease at 13 years of age.

Moi Teaching and Referral hospital provided care to all the patients who sought treatment regardless of their referral status. It therefore catered for both referral and non-referral cases.

Majority (107 patients, 53.8%) of the patients presented to MTRH directly from home while 92(46.2%) were referrals from other health facilities.

Among those who came straight from home 82.2% (88 patients) took more than 24hours after the onset of the symptoms compared to 86.7% (78 patients) of those who were referrals from other health facilities. The relationship between duration of symptoms and referral status was not statistically significant (p=0.396), ***Chi Square***).

4.2. Diagnosis and causes of intestinal obstruction

4.2.1. Dominant symptoms and signs

Patients who were diagnosed with intestinal obstruction presented with diverse symptoms. Figure 2 below shows the dominant symptoms and signs that the patients presented with at the time of admission.

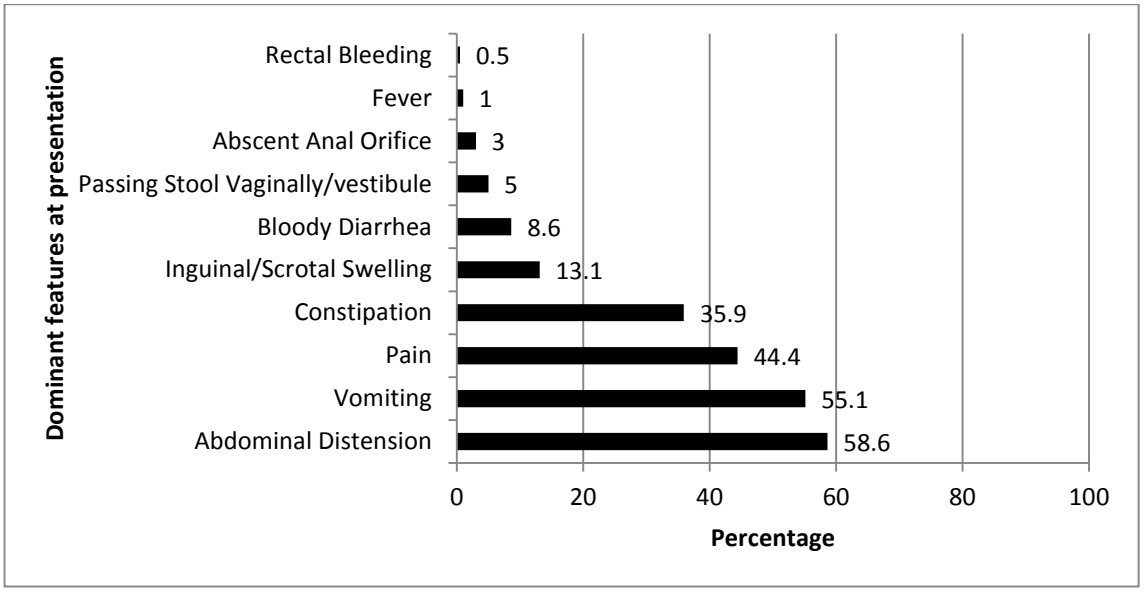

Figure 2 .Dominant signs and symptoms

As shown in figure 2 above, the cardinal features of intestinal obstruction included abdominal distension (58.6%), vomiting (55.1%), abdominal pain (44.4%) and constipation (35.9%). However, none of these features was found in all the patients.

4.2.2. Investigations done

At the MTRH, patients suspected of having intestinal obstruction were mainly investigated at the accident and emergency (A/E) unit before being admitted to the various surgical units. The common radiological/imaging tests ordered were plain abdominal x-rays or abdominal ultrasound. Some patients underwent both abdominal x-ray and ultrasound scans.

Since the hospital did not have protocols on investigating these patients, the choice of the tests to be done was made by the clinician(s) (Clinical officer, Medical officer, Registrar or Consultant surgeon) who attended to these patients at the A/E unit. Some patients did not have any imaging done and the diagnosis was therefore clinical as was the case for inguinal hernias.

Abdominal x-ray was done in 97 (48.7%) of the patients studied while abdominal ultrasound was done in 57 patients (28.6%). None of the patients underwent CT scan for

diagnosis of intestinal obstruction. The laboratory tests done in these patients at admission point were Complete blood count (192 patients, 96.5%) and Urea, Electrolyte and Creatinine (193 patients, 97%), largely to assess the physiological derangements in these patients.

In table 3 below, important aspects of the investigations conducted are highlighted. Abdominal x-ray and ultrasound findings were classified as “normal” or “abnormal”. The “normal” findings included any findings that were not suggestive of intestinal obstruction while “abnormal” findings included any finding suggestive/ diagnostic of intestinal obstruction.

On abdominal x-ray, findings that were considered “abnormal” (diagnostic of intestinal obstruction) included multiple air-fluid levels, distended bowel loops and absence of gas in distal loops of bowel. On abdominal ultrasound, the findings that suggested intestinal obstruction and hence classified as “abnormal” included distended bowel loops, increased peristalsis, difference in mucosal folds around the transitional point and free peritoneal fluid suggestive of ischemia.

Laboratory findings were also grouped into “normal” and “abnormal” categories based on the MTRH laboratory reference ranges. Haemoglobin was included largely for the assessment of general well-being of the patients together with assessment of the dehydration status. The white cell count was included for the purpose of assessing the systemic inflammatory response mounted by the patient and as a sign of septicaemia whereas serum potassium was included as a possible marker of bowel strangulation.

Table 3.Investigations done to confirm or assist in diagnosis

Investigation	Frequency of Normal results (%)	Frequency of abnormal results (%)
Abdominal x-ray	3 (3.1)	94 (96.9)
Abdominal Ultra sound	6 (10.5)	51 (89.5)
Haemoglobin (HB)	120 (63.2)	70 (36.8)
White blood cell count (WBC)	97 (50.5)	95 (49.5)
Potassium (K+)	126 (65.3)	67 (34.7)
Urea	137 (72.1)	53 (27.9)

4.2.3. Causes of intestinal obstruction

The causes of intestinal obstruction among the patients studied were diverse. These causes were sub-classified according to the patients' age into "children (≤12 years)" and "adult (>12 years)" groups as shown in table 4 below. The mean ages among patients in a specific group are also indicated in the table.

Table 4.Aetiology of intestinal obstruction and the mean age at presentation

Cause of obstruction	**Children ≤12 yr Freq(%)**	**Adult>12 yr Freq(%)**	**Mean age in yr Mean(SD)**	**Overall Freq(%)**
Adhesions	4(9.3)	39 (90.7)	33(19.1)	43 (21.6)
ARM*	35 (100)	0 (0)	0.28(0.6)	35 (17.6)
Volvulus	3 (8.8)	31 (91.2)	42.4(19.6)	34 (17.1)
Intussusception*	22 (91.7)	2 (8.3)	5.2(13.4)	24 (12.1)

Hernia	4 (21.1)	15 (78.9)	34.8(25.5)	19 (9.5)
Tumour	1 (7.7)	12 (92.3)	50.5(21.4)	13 (6.5)
Paralytic ileus	0	12 (100)	39.7(19.5)	12 (6.0)
Hirschsprung's disease*	4 (66.7)	2 (33.3)	5.8(6.9)	6 (3.0)
Faecal impaction	1 (16.7)	5 (83.3)	39.3(26.2)	6 (3.0)
Bowel atresia*	5(100)	0 (0)	0.098(0.2)	5 (2.5)
Abdominal TB	0 (0)	1 (100)	36	1 (0.5)
Helminthiasis	1 (100)	0 (0)	4	1 (0.5)
Total	80 (40.2)	119 (59.8)	25.6(24.7)	199 (100.0)

*The patients in these categories had extensive age variations and therefore median ages at presentation were also calculated to allow appropriate interpretation. The medians were as follows: ARM-12days (IQR-116.8); Intussusception-259days (IQR-1350); Hirschsprung's disease- 3years (IQR-13.7) and Bowel atresia-8days (IQR-80)

Overall, adhesions, ARM, bowel volvulus and intussusception were the four leading causes of intestinal obstruction in that order while abdominal TB and helminthiasis were the least common. Among the children, ARM and intussusception were the commonest causes of intestinal obstruction while among adults, adhesions and bowel volvulus were the commonest. Adhesive intestinal obstruction constituted 43 patients (34.1%) of the subjects with small bowel obstruction (126 patients).

Out of the 43 cases of adhesion, 27 cases had prior abdominal surgery as specified in table 5 below.

Table 5.Prior abdominal operations among patients with adhesions

Prior operation	**Frequency (%)**
Appendectomy	7 (25.9)
Laparotomy for previous intestinal obstruction	4 (14.8)
Hernia surgery	3 (11.1)
Hysterectomy	3 (11.1)
Surgery for penetrating abdominal injury	2 (7.4)
Others*	8 (29.6)
Total	**27 (100)**

*Includes surgeries for: Intra-abdominal abscess, Perforated peptic ulcer, Caeserian section, Ovarian cancer, Hemicolectomy for unspecified reason each with 1 case and 3 unspecified** previous abdominal surgeries

**Unspecified cases- these are patients who had undergone previous abdominal surgeries but no further information was available on previous diagnosis or the surgery done

Appendectomy was the single commonest prior abdominal operation among the patients presenting with adhesions. Other operations included laparotomy for previous intestinal obstruction, hernia surgery and hysterectomy. In our setting, it was common for patients to undergo surgery but without clear patient information on the diagnosis and exact operation performed. In this study, for instance, 3 patients had previously undergone laparotomy for diagnosis they did not know. These were grouped among the "unspecified" subgroup in the "Others" category.

In this study, the 35 children with ARM were not categorised further into the various types of ano-rectal malformations and were considered and analysed as a uniform group.

A total of 34 patients had bowel volvulus. The commonest site was the sigmoid colon with 17 patients (50%) followed by small bowel volvulus with 14 patients (41.3%). Other sites involved included the transverse colon, caecum and ileo-sigmoid knotting each with 1 case (2.9%).

A total of 24 patients had intussusception with all of them having been children. The commonest type was ileo-colic which contributed 83.3% (20) of the patients. Ileo-ileal intussusception was found in 3 patients (12.5%) while the colo-colic type was found in 1 patient (4.2%).

Among the 19 patients who had obstructing hernia, 73.6% (14 patients) were of the inguinal type. Two patients (10.5%) had epigastric hernia while mesenteric defect hernia, incisional hernia and diaphragmatic hernia contributed 1 patient (5.3%) each.

Majority of the patients (126 patients, 63%) had small bowel obstruction while the remaining 73 patients (37%) had large bowel obstruction. The referral status of patients with different diagnoses was as indicated in figure 3 below.

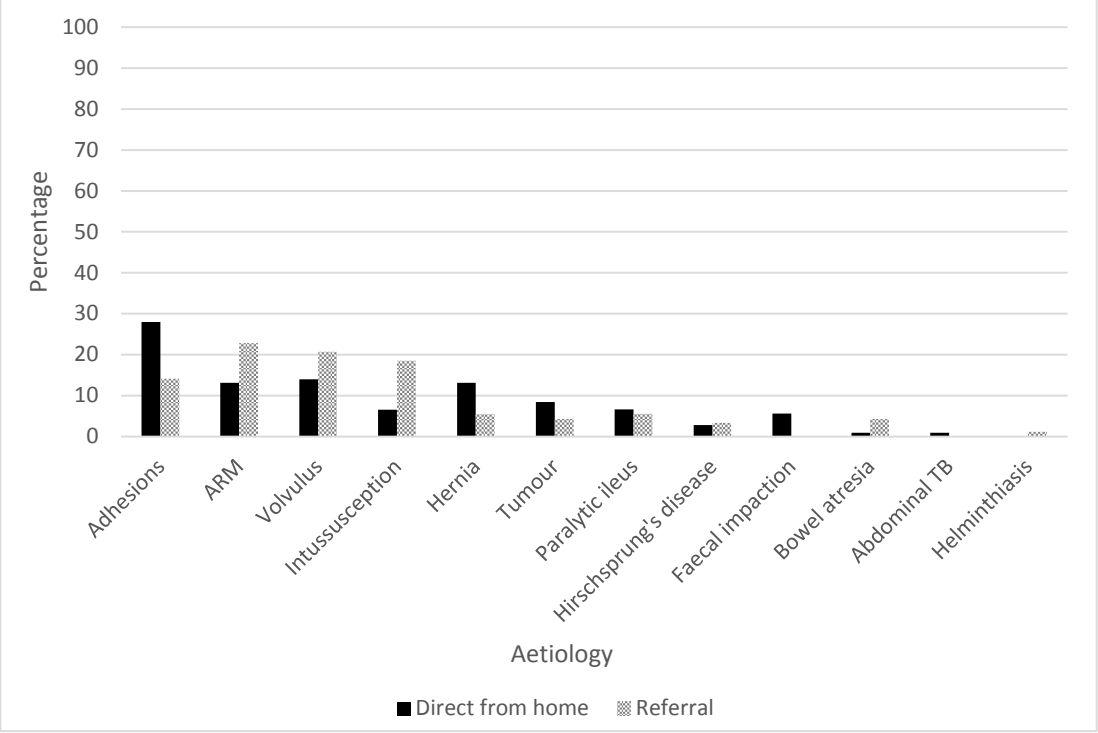

Figure 3.Referral status for different aetiologies of intestinal obstruction

The highest proportions of referral cases were among patients with ARM, bowel volvulus and intussusception as shown in the figure above.

4.3. Treatment of intestinal obstruction patients at the MTRH

4.3.1. Supportive treatment: Fluid resuscitation and bowel decompression

Majority (193, 97%) of the patients diagnosed with intestinal obstruction were not allowed to take anything orally. Exceptions to this dictum were made in six (3%) neonates who had ARM with fistula and presented several days or weeks having been feeding and passing stool albeit with difficulty. These special cases did not have either persistent abdominal distension or vomiting and were allowed to continue feeding orally largely due to lack parenteral nutrition in the hospital as they awaited surgery.

Parenteral intravenous fluid was administered in intestinal obstruction patients both for correction of dehydration as well as maintenance. The quantity and composition of the administered fluid varied among patients as prescribed by the clinician, often a registrar in general surgery or a consultant surgeon.

Evaluation of the effectiveness of rehydration was based on urine output of 0.5 - 1ml/kg/hour. In children however, urine output of between 1-2ml was considered adequate. Among the 34 patients treated conservatively, 28 (82.4%) received adequate amounts of resuscitation fluid as depicted by adequate urine production. As illustrated in table 6 below, among the patients treated surgically, only 38.8% and 57.3% received adequate fluids in the pre- and post-operative periods respectively. Many (93 pre-operative and 68 post-operative) patients were unmonitored.

Table 6.Adequacy of urine output in the operatively managed group

	Frequency (%) pre-operatively	Frequency post-operatively (%)
Adequate urine	64 (38.8)	94 (57.3)
Inadequate urine	8 (4.8)	3 (1.8)
Not monitored	93 (56.4)	68 (40.9)
Total	165 (100)	164* (100)

*One patient died while awaiting surgery after a period of failed conservative care

Apart from few (6) neonates who were allowed to continue feeding pre-operatively after presenting late with ARM and functioning fistulas, all the other patients had nasogastric tube (NGT) decompression done. In all patients, bowel decompression was continued for varying duration of the post-operative period (range 2-6 days) until the patient's bowel function was considered to have recovered sufficiently. This was done clinically by the presence of bowel sounds and passage of stool/ flatus. None of the NGT was accurately monitored and actively managed throughout its use.

4.3.2. Use of antimicrobials

Out of the 165 patients in the operative group 146(88.5%) were given antimicrobials pre operatively. Post-operatively, all of them received parenteral antimicrobials. Among the 34 patients managed conservatively,27(79.4%) were on antimicrobials from the time the diagnosis of intestinal obstruction was made. The choice of antimicrobials given was made by the attending surgical team largely based on the suspected organisms being targeted. Table 7 below shows the varying range and frequency of antimicrobials used.

Table 7: Choice of antimicrobials

Antimicrobial	Frequency (%)
Ceftriaxone	151 (87.3)
Metronidazole	134 (77.4)
Amikacin	13 (7.5)
Penicillin	12 (6.9)
Gentamicin	11 (6.4)
Meropenem	5 (2.9)
Ceftriaxone & Salbactum	3 (1.7)
Amoxicillin &clavulanate	2 (1.2)
Cefepime	2 (1.2)
Ciprofloxacin	1 (0.6)
Vancomycin	1 (0.6)

4.3.4 Definitive treatment

4.3.4.1. Mode of definitive treatment

Majority (155 patients, 78%) of the patients were offered surgery as the preferred mode of treatment at the point when a diagnosis of intestinal obstruction was made. This was based on the suspected aetiology.

Among the 44 patients who were put on conservative management, 11(25%) failed to improve and were therefore changed to the operative group. One of these patients however died while awaiting surgery. The remaining 33 patients (75%) were successfully managed non-operatively. The duration of conservative management (up to resolution or decision to operate) ranged from 1 to 19 days with a mean of 4±3.8days.

For all patients who were eventually operated on (operative from outset and those who failed conservative treatment), the duration from admission to operation took between 0 and 43 days with a median of 1 day (IQR=1).

4.3.4.2. Bowel strangulation

Majority (126 patients, 76.8%) of the patients who underwent surgery had viable bowels (not gangrenous) while the remaining 38 patients (23.2%) had gangrenous bowel. Among these 38 patients, 18 (47.4%) were children. The overall rate of bowel gangrene among intestinal obstruction patients at MTRH was 19.2%. The figure below shows the diagnoses among the patients who had gangrenous bowel.

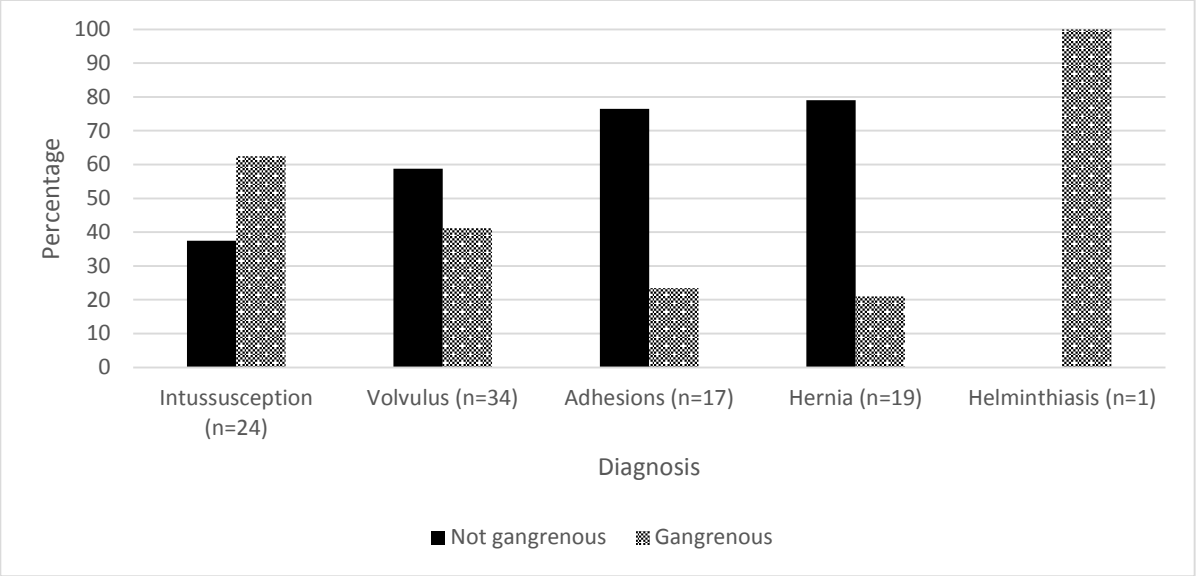

Figure 4 .Aetiology of intestinal obstruction among patients with bowel gangrene

From the figure above, intussusception and bowel volvulus were the commonest causes of intestinal obstruction among the patients with gangrenous bowel.

The influence of various factors on development/ diagnosis of bowel gangrene was evaluated as illustrated in table 8 below.

Table 8.Association between various variables and bowel viability

		Status of bowels		p-value
		Viable (%)	Gangrenous(%)	
K+	Normal	74 (74)	26 (26.0)	0.156
	Abnormal	51 (83.6)	10 (16.4)	
	Missing*	2	2	
WBC	Normal	63 (76.8)	19 (23.2)	0.919
	Abnormal	62 (77.5)	18 (22.5)	
	Missing*	2	1	
Temperature	Normal	95 (81.2)	22 (18.8)	0.149
	High (>37.5^{o}C)	20 (69.0)	9 (31.0)	
	Missing*	12	7	
Adult systolic Bp at admission	Low (<90mmHg)**	5 (50.0)	5 (50)	0.022
	Normal (≥90mmHg)**	55 (82.1)	12 (17.9)	
	Missing***	67	21	

*****These are patients who did not have these parameters taken/tested at admission

** These figures represent adult systolic BP measurements

***This large number represents many patients whose BP at admission was not taken at admission, the vast majority of who were children due to lack of suitable BP cuffs at admission points.

As depicted in the table above, low adult systolic BP at admission seemed to predict presence of bowel gangrene (p-value 0.022). All the other parameters in the table did not have any significant association with bowel gangrene.

There was a significant association between abnormal blood urea levels at admission and presence of bowel gangrene (p=0.029) but not with development of complications (p=0.352).

Among the 38 patients who had gangrenous bowel, 31 (81.6%) underwent resection and primary anastomosis while 7(18.4%) had stomas fashioned.

4.4. Outcome of intestinal obstruction and associated factors

4.4.1. Morbidity: Complications

A total of 56 complications were identified among forty seven (23.6%) patients. Children constituted 24 (51.1%) of these 47 patients. The specific medical and surgical complications identified among the patients treated for intestinal obstruction at the MTRH are as depicted in table 9 below.

Table 9. Complications

Complication	Frequency (%)
Septicaemia	18 (32.1)
Wound sepsis/ Surgical site infections	9 (16.1)
Pulmonary*	8 (14.3)
Persistent ileus (>72 hours)	5 (8.9)
Renal failure/ injury	5 (8.9)
Multiple organ failure	2 (3.6)
Others**	9 (16.1)
Total	56 (100)

* Pulmonary complications were pneumonia and atelectasis each constituting 4 patients

**These included electrolyte derangement in 2 patients (5.6%) and gut necrosis, enterocutaneous fistula, intra-abdominal bleeding, stoma retraction, stoma prolapsed,

malnutrition and urethral injury following catheterization; each occurring in 1 patient (2.8%).

Septicaemia, wound sepsis and pulmonary complications were the commonest complications encountered among the study subjects as depicted in the table above.

Various factors were evaluated for their association with complication development as depicted in tables 10 and 11 below:

Table 10.Association between various variables and complication development (excluding death)

		Complication development		p-value
		No (%)	Yes (%)	
Temperature at admission	Normal	124 (82.7)	26 (17.3)	0.008
	High (>37.5^{o}C)	19 (61.3)	12 (38.7)	
WBC	Normal	77 (79.4)	20 (20.6)	0.273
	Abnormal	69 (72.6)	26 (27.4)	
Presence of co-morbidity	No	126 (79.2)	33 (20.8)	0.058
	Yes	26 (65.0)	14 (35.0)	

As shown in the table above, elevated temperature at admission seemed to predict development of complications (p-value 0.008), while white blood cell count and presence of co-morbidity did not have significant association with complications.

Table 11.Association between antimicrobial use and development of septicaemia or wound sepsis

		Presence of either wound sepsis or sepsis		Total (%)
		No (%)	Yes (%)	
Antibiotic use	Yes	153 (88.4)	20 (11.6)	173 (100)
	No	20 (76.9)	6 (23.1)	26 (100)
Total		173 (86.9)	26 (13.1)	199 (100)

There was no significant association between antimicrobial use and development of either wound sepsis or septicaemia (χ^2 (1) = 2.639, p=0.104).

4.4.2.Morbidity: Length of stay

The average length of hospitalization was 8.5 ±6.7days with a range of 1 to 46 days. On average those who had co-morbidities took longer in the hospital ($\bar{x}$ = 12.2±9.3days) than those who did not have any co-morbidities ($\bar{x}$ = 7.6±5.5days). This difference was statistically significant (t(46) = -2.939, p=0.005). Similarly, those who developed complications took longer in the hospital ($\bar{x}$ = 10.9±8.7days) than those who did not have complications ($\bar{x}$ = 7.8±5.8days) with a statistically significant difference (t(59) = -2.335, p=0.023). However, there was no statistically significant difference between the lengths of stay among children compared to adults ((t) p=0.56).

4.4.3. Hospital mortality and associated factors

The overall mortality recorded in this study due to intestinal obstruction was 15% (30 patients). The mortality was 18.8% in children and 12.6% among subjects aged >12 years. Various factors were evaluated for their capability to predict mortality in intestinal obstruction patients as shown in table 12 below:

Table 12.Association between various variables and eventual outcome (Alive /Dead)

		Outcome		p-value
		Alive (%)	Dead (%)	
Presence of complications	No	142 (93.4)	10 (6.6)	<0.0001
	Yes	27 (57.4)	20 (42.6)	
Sex	Male	99 (84.6)	18 (15.4)	0.884
	Female	70 (85.4)	12 (14.6)	
Any antibiotic given	Yes	145 (83.8)	28 (16.2)	0.259
	No	24 (92.3)	2 (7.7)	
WBC	Normal	82 (84.5)	15 (15.5)	0.950
	Abnormal	80 (84.2)	15 (15.8)	
Temperatures at admission	Normal	135 (90.0)	15 (10.0)	0.000
	High	20 (64.5)	11 (35.5)	
Systolic Bp at admission*	Low (<90mmHg)	11 (73.3)	4 (26.7)	0.033
	Normal (>90mmHg)	88 (91.7)	8 (8.3)	
Presence of co-morbidity	No	140 (88.1)	19 (11.9)	0.014
	Yes	29 (72.5)	11 (27.5)	

*Among adult patients

Elevated body temperature at admission, low systolic BP at admission, presence of co-morbidity and development of complications had significant association with mortality while sex, use of antibiotics and abnormalities in white blood cell count did not have any such associations.

4.4.4. Impact of various variables on overall complications including death

Further analysis was done to assess any associations between various variables and development of any complication including death.

There was no significant association between age and presence of complications including death (p=0.426) and likewise, there was no significant association between duration of illness and presence of complications including death (p=0.371). Other variables evaluated are shown in table 13 below:

Table 13.Association between various variables and presence of complications including death

		Presence of complications including death		p-value
		No (%)	Yes (%)	
Status of bowels	Not gangrenous	95 (76.0)	30 (24.0)	<0.0001
	Gangrenous	17 (44.7)	21 (55.3)	
Sex	Female	56 (68.3)	26 (31.7)	0.423
	Male	86 (73.5)	31 (26.5)	
ASA classification	I & II	91 (73.4)	33 (26.6)	0.012
	III , IV & V	12 (48.0)	13 (52.0)	
ASA I & II	Elective	14 (82.4)	3 (17.6)	0.558
	Emergency	79 (73.8)	28 (26.2)	
ASA III , IV & V	Elective	1 (16.7)	5 (83.3)	0.364
	Emergency	8 (42.1)	11 (57.9)	
ASA classification	Elective	15 (65.2)	8 (34.8)	0.716
	Emergency	87 (69.0)	39 (31.0)	
Prior abdominal	No	113 (69.8)	49 (30.2)	0.295

surgery history	Yes	29 (78.4)	8 (21.6)	
Level of obstruction	Small bowel	85 (67.5)	41 (32.5)	0.110
	Large bowel	57 (78.1)	16 (21.9)	
Co-morbidity presence	No	120 (75.5)	39 (24.5)	0.010
	Yes	22 (55.0)	18 (45.0)	

From the above table, bowel gangrene, ASA classification (I &II vs. ≥III) and presence of co-morbidity had significant association with development of complication including death while the rest of the factors considered did not have significant association. However, analysis for associations was also done on the same factors to control for any confounders using logistic regression. This showed that presence of gangrene was the only variable that had a significant association(p-value 0.015) with development of complication (including death) while controlling the effects of all other variables in the model.

4.4.5. Cause of death

The causes of death among the patients studied were as shown in the chart below:

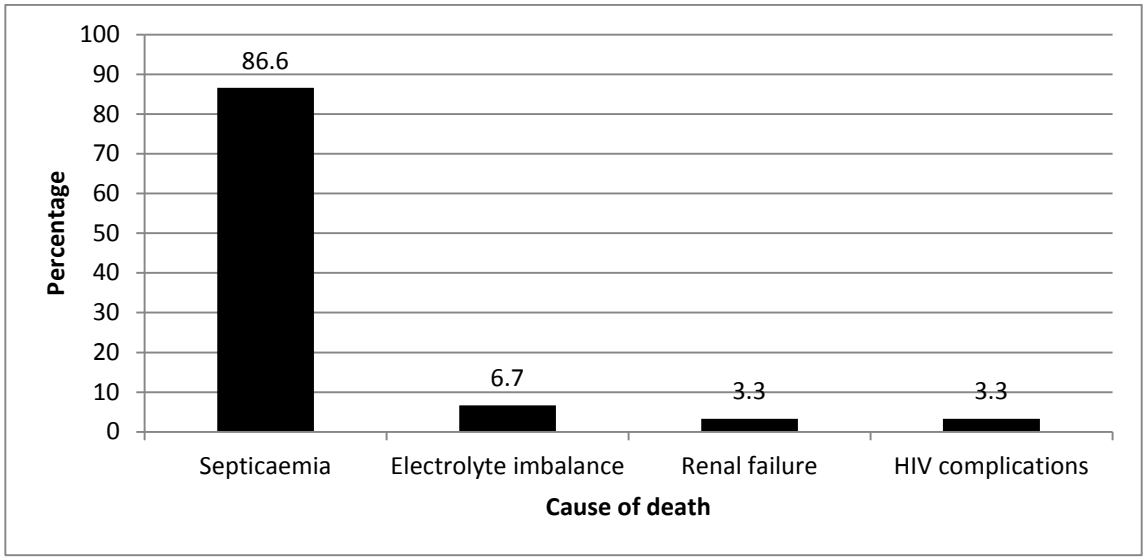

Figure 5.Cause of death

Septicaemia was the commonest cause of death contributing 86.6% of the cases and largely accompanied by multiple organ failure.

The demographic features of the patients who died are represented in table 14 below:

Table14. Demographic characteristics of the mortality cases

Age group	Male Frequency (%)*	Female Frequency (%*)	Total
0-9	8 (16)	5 (18.5)	13
10-19	4 (40)	1 (16.7)	5
20-29	1 (7.1)	1 (8.3)	2
30-39	1 (10)	0 (0)	1
40-49	3 (25)	1 (20)	4
50-59	1 (12.5)	3 (25)	4
60-69	0 (0)	0 (0)	0
70-79	1 (16.7)	1 (25)	2
80-89	0 (0)	0 (0)	0
Total	18 (15.4)	12 (14.8)	30

*The percentages indicated represent proportions of those who died compared with all patients in that particular category.

The case-specific mortality rates are represented in table 15 below.

Table15. Case-specific mortality

Cause of intestinal obstruction	Case fatality Frequency (Rate, %)
Paralytic ileus/peritonitis	5(50.0)
Bowel atresia	2(40.0)
Intussusception	8(33.3)
Volvulus	6(17.6)
Tumour	2(15.4)
Adhesions	4(9.3)
ARM	3(8.6)
Total	30(15.1)

Peritonitis and paralytic ileus had the highest case-specific mortality rates of 50% followed by bowel atresia (40%) and intussusception (33.3%). There were no fatalities among the patients who had hernia, Hirschsprung's disease, faecal impaction, abdominal TB and Helminthiasis.

CHAPTER FIVE: DISCUSSION

Demography of the patients

The age of patients in this study varied widely, highlighting that intestinal obstruction affects all age groups. Worldwide, older people are more commonly affected by intestinal obstruction(Jumbi, 2014; Qureshi & Khan, 2008). However in this study, the median age of the patients was 22 years likely due to the large number of paediatric age-group (≤12 years) patients in this study similar to what had been reported in other studies. In a study conducted in Rwanda, the mean age was 31.8 years(Ntakiyiruta & Mukarugwiro, 2009) and this could be considered similar to this study with relatively young patients. Furthermore, countries like Kenya with low life expectancy would have younger patients presenting with intestinal obstruction (Jumbi, 2014; Khan et al., 2014; Malik et al., 2010; Nuhu & Jah, 2010; Oladele et al., 2008).

The age-group most affected was 0-9 year bracket similar to an earlier study conducted by Muyembe et al(Muyembe & Suleman, 2000). Majority of these patients had congenital abnormalities predominantly anorectal malformations. This was similar to a study conducted in Nigeria on neonatal intestinal obstruction(Ameh & Chirdan, 2000). Indeed, it may be expected that congenital anomalies would mainly be an issue among children(Hayanga et al., 2005; Ogundoyin et al., 2009). Other causes of intestinal obstruction in this group such as intussusception were also commonly encountered. The least commonly affected group was age bracket 80-89 years most likely due to low life-expectancy in Kenya.

In other previously conducted studies, males have been shown to be more commonly afflicted by intestinal obstruction (Asad et al., 2011; Chalya et al., 2014; Qureshi & Khan, 2008; Souvik et al., 2010). Muyembe et al reported a male to female ratio of 2.8:1(Muyembe & Suleman, 2000), Jumbi found a ratio of 2.5:1(Jumbi, 2014) while in a

study conducted in Pakistan, the ratio was 1.01:1(Khan et al., 2014). Another study conducted in Nigeria had a male: female ratio of 1.7:1(Oladele et al., 2008) and this fact was no different in this study where the male to female ratio was 1.4:1. Similar ratios have also been reported in studies conducted in Rwanda and Saudi Arabia(Malik et al., 2010; Ntakiyiruta & Mukarugwiro, 2009).

Co-morbidity

Fifty eight co-morbidities were encountered among forty patients. Hypertension and cardiac disease were the commonest as shown in table 2. These two diseases have been reported to be more common among patients in their middle-age to old age(Jumbi, 2014) and emphasize the need for awareness among health care-givers of their possible presence in the surgical patient. Their presence may not only influence the management of the surgical patient but also the outcome of such patients. The third most common co-morbidity was Human Immunodeficiency Virus (HIV) infection which too may influence care and outcome of the surgical patient admitted with intestinal obstruction (Ahmed et al., 2010). On the other hand, diabetes mellitus and acute infective conditions were uncommon among the patients studied.

The patients in this study who were operated on were assigned American Society of Anaesthesiologists (ASA) classification I to IV. Majority of these patients belonged to ASA class II while ASA IV had the least. None of the study subjects belonged to ASA V or VI classes. This is probably because the sickest patients never made it to the referral hospital due to difficulties in our referral system in Kenya. More stable patients belonging to lower ASA classes would therefore be encountered in such a situation. The vast majority of those who were operated on were emergency cases. However, some patients who presented sub-acutely or chronically were operated on semi-electively and

were therefore assigned to the “Elective” ASA classification for the purpose of this study.

Patient presentation

The duration between onset of symptoms and presentation to hospital varied extensively. Majority of the patients presented late to hospital. Nonetheless, many of the patients studied had an acute presentation while only a minority of patients had a chronic presentation. A study on childhood intussusception conducted in the same setting as this study revealed the average duration of symptoms was 5 days (Kuremu, 2004) even for a condition as acute as intussusception. Similar results were found in another study conducted at Muhimbili in Tanzania (Carneiro & Kisusi, 2004).The median duration at presentation was 4 days in a Nigerian study on neonatal intestinal obstruction(Ameh & Chirdan, 2000).

The variability in duration before presenting to hospital is explained by the diversity of the causes of intestinal obstruction in these patients. Some causes would generally have a more acute presentation unlike other causes with subtle initial features. Causes of intestinal obstruction such as bowel volvulus lead to acute presentations while other causes present a more chronic disease progression as seen in many tumours. The wide variation in duration of illness among the patients studied may also point to the diversity of our patient characteristics in terms of their level of disease awareness and also the ease of accessing health facilities. This was highlighted by a patient who presented to hospital for the first time with Hirschsprung’s disease at 13years of age. Many children presented to hospital days or even weeks after having been born with ARM. Such delays were also noted by Kuremu et al (Kuremu & Jumbi, 2006) in another study at the MTRH and Ameh et al in Nigeria (Ameh & Chirdan, 2000). Similar findings have been reported by other authors especially from the developing countries (Chalya et al., 2014;

Holcombe, 1995; Malik et al., 2010; Millar et al., 2000; Ntakiyiruta & Mukarugwiro, 2009; Oladele et al., 2008).

Majority of the patients in this study had come directly from home without having been attended to in other health facilities. Despite the MTRH being a tertiary health–care provider, there is no requirement that any patient ought to have been attended to at a lower-level (primary and secondary levels) before seeking treatment there. This is unlike what was reported in a study from Rwanda (Ntakiyiruta & Mukarugwiro, 2009). The hospital therefore offers primary and secondary level services too. The remaining proportion presented as referral cases highlighting the central position the MTRH holds as a regional referral hospital.

The large proportion of referral cases may partly explain for some delay in patient presentation due to the inevitable loss of time in the referral processes. However, majority of the patients who presented to MTRH from their homes still took more than 24hours after onset of illness which was comparable to the referral cases.

The cardinal features of intestinal obstruction are vomiting, abdominal distension, abdominal pain and constipation/obstipation (Asad et al., 2011; Hayanga et al., 2005; Jackson & Raiji, 2011; Kahi & Rex, 2003; Qureshi & Khan, 2008; Ullah et al., 2011). As shown in figure 2, the most common presentation was abdominal distension followed by vomiting. Kuremu found similar presentation while studying childhood intussusception in the same setting (Kuremu, 2004). Other authors have reported similar findings (Malik et al., 2010). This may highlight the community perception of the different symptoms which to them signify a serious disease process requiring medical attention. More importantly, however, is the fact that the leading causes of intestinal obstruction in these patients are known to present with these symptoms as the dominant

features but with none of the features being pathognomonic of intestinal obstruction. None of the cardinal features therefore was found in all the patients studied.

The presenting features depend on many factors among them the level and degree of obstruction (Hayanga et al., 2005; Jackson & Raiji, 2011; Kahi & Rex, 2003; Millar et al., 2000). Regardless of the intestinal obstruction cause however, there are common features that mainly emanate from reduced intravascular volume (due to reduced intake, vomiting and fluid sequestration in bowel) leading to electrolyte imbalances, hemodynamic instability, oliguria and renal dysfunction(Hayanga et al., 2005; Kahi & Rex, 2003).

Investigations

The two widely available modalities of imaging for aiding in the diagnosis of intestinal obstruction were abdominal x-ray and ultrasound. At the MTRH, there were no available protocols guiding the process of investigating patients suspected of having intestinal obstruction and therefore no standard way of investigating these patients. The investigations ordered largely depended on the clinician's judgment. While abdominal x-ray has particularly been proven to be of value over the years as an adequate and relatively cheap tool in diagnosing intestinal obstruction (Ameh & Chirdan, 2000; Carneiro & Kisusi, 2004; Hayanga et al., 2005; Maglinte et al., 2001; Marinis et al., 2009; Millar et al., 2000; Musoke et al., 2003; Roggo & Ottinger, 1992), it was done in a minority of patients. Of these, nearly all of them had findings suggestive/ diagnostic of intestinal obstruction. These included air-fluid levels, grossly distended bowel loops and collapsed bowel loops distal to the site of obstruction. The high proportions of x-rays with significant findings points to the usefulness of this test in diagnosing intestinal obstruction cases though its sensitivity and accuracy has been variably reported by different authors (Hayanga et al., 2005; Jackson & Raiji, 2011; Maglinte et al., 2001).

Some authors have recommended abdominal x-rays be done in all patients suspected to have intestinal obstruction (Kahi & Rex, 2003).

Despite some sources indicating the ineffectiveness of ultrasound in diagnosis of intestinal obstruction due to gaseous distension of the bowel(Di Saverio et al., 2013), ultrasound was done in 28.6% of patients. Of these, the vast majority of the tests done had findings suggestive/ diagnostic of intestinal obstruction which was in line with other authors' findings that this limitation was not significant in the clinical setting(Jackson & Raiji, 2011; Marinis et al., 2009; Musoke et al., 2003; Qureshi & Khan, 2008).

In this study, none of the patients underwent CT scan or contrast study for the purpose of diagnosis of intestinal obstruction contrary to many sources (S.-C. Chen et al., 2005; Di Saverio et al., 2013; Dwivedi et al., 2009; Frazee et al., 1988; Hayanga et al., 2005; Jackson & Raiji, 2011; Kahi & Rex, 2003; Maglinte et al., 2001; Marinis et al., 2009; Qureshi & Khan, 2008) that highlight their importance. Other tests that were done included Full Blood Count and Urea, Creatinine and Electrolytes.

Elevated WBC may signify bacterial translocation into the blood stream with attendant systemic inflammatory response or sepsis while elevated urea signify dehydration (Jackson & Raiji, 2011). These tests are non-specific and they largely play a complimentary role in these patients with intestinal obstruction (Hayanga et al., 2005; Kahi & Rex, 2003) to assess the pathophysiological changes.

In this study, abnormalities in WBC did not have any association with bowel gangrene which would inevitably be accompanied by bacterial translocation. Abnormality in WBC count was also not associated with development of complications or eventual outcome contrary to what might be expected with significant bacterial translocation. On the contrary, there was a significant association between elevated blood urea and bowel

gangrene. Indeed patients with gangrene would be expected to be sicker and with more physiological derangements such as dehydration.

Endoscopy was done only in few patients with features of large bowel obstruction. It was mainly done as a complimentary test to allow biopsy rather than for diagnosis of intestinal obstruction per se. None of our patients underwent colonoscopy for intervention purposes. Various studies have shown the usefulness of this test both in diagnosis and treatment of certain causes of intestinal obstruction (Kahi & Rex, 2003; Katsanos et al., 2010; Marinis et al., 2009). However endoscopic assessment of bowel ischaemia has limitations(Kahi & Rex, 2003) but nonetheless, there is need for large hospitals like the MTRH to embrace such technology in patient care even in the acute settings.

Causes of intestinal obstruction

In this study, adhesion was found to be the commonest cause of intestinal obstruction among the patients treated at MTRH. It constituted 34.1% of all small bowel obstruction (SBO) patients. This is in-keeping with previously conducted studies in the hospital, the region and elsewhere (Asad et al., 2011; S.-C. Chen et al., 2005; Kuremu & Jumbi, 2006; Lawal et al., 2005; Malik et al., 2010). In contrast though, a study conducted in Tenwek mission hospital in Kenya(Ooko et al., 2015) showed sigmoid volvulus as the commonest cause of intestinal obstruction followed by adhesions. In this study, the vast majority of adhesive intestinal obstruction was in adults largely due to prior abdominal surgeries. Such history of prior abdominal surgery would be expected to be dominant among adults as compared to children. On the contrary, some patients had no history of abdominal surgery and their adhesions probably resulted from previous intra-abdominal infections that did not require surgical intervention(Ogundoyin et al., 2009).

In the Western/ developed nations, adhesions as the most common cause of intestinal obstruction has been shown by various scientific studies (Hayanga et al., 2005; Kadhim J. O. , 2011; Maglinte et al., 2001; Ullah et al., 2011). This is largely attributed to availability of abdominal surgery services in these areas with the attendant risk of post-operative adhesions. The same trend has been noted in developing countries like Kenya as surgical services become more available (Kuremu & Jumbi, 2006; Lawal et al., 2005; Oladele et al., 2008). This fact has been further emphasized by this study.

Contrary to many studies (Di Saverio et al., 2013; Hayanga et al., 2005; Kahi & Rex, 2003; Stewardson et al., 1978) which show the proportion of adhesive SBO to be 60-80% of all cases of SBO, this study revealed a significantly lower figure of 34.1%. This is likely due to relative dominance of other causes of intestinal obstruction such as hernia and bowel volvulus.

The commonest surgeries conducted previously were appendectomy and laparotomy (mostly for prior intestinal obstruction) as shown in table 5. Appendectomy was the single most common previous abdominal surgery among these patients. This was similar to what Kuremu et al(Kuremu & Jumbi, 2006) found in another study conducted at the same hospital as well as in other studies (S.-C. Chen et al., 2005; Hayanga et al., 2005; Jumbi, 2014; Kahi & Rex, 2003; Khairy et al., 2005; Lawal et al., 2005; Malik et al., 2010). Other surgeries included inguinal hernia repairs and hysterectomy similar to other studies(Jackson & Raiji, 2011).Lower abdominal and pelvic surgeries have largely been implicated in adhesive intestinal obstruction mainly due to the fact that the bowel is normally tethered cephalad by the mesenteric root leaving it more mobile caudad within the pelvis(Hayanga et al., 2005). Any adhesions forming in this region is therefore more likely to entangle the bowel loops.

Anorectal malformations of various subtypes were noted to be a common cause of intestinal obstruction in patients presenting at the MTRH. As would be expected, all the ARM cases were in children. The large number of ARM cases is explained by the fact that MTRH is the only facility with enough capacity to handle these cases in the Western part of Kenya and one of only two facilities in Kenya where major paediatric surgical services are available. Majority of these cases were therefore referral cases from other health facilities in the region as shown in figure 3. Other congenital causes of intestinal obstruction noted in this study were bowel atresia and Hirschsprung's disease. In a study conducted in Nigeria, ARM constituted the vast majority(65%) of neonatal intestinal obstruction while bowel atresia contributed 6.7%(Ameh & Chirdan, 2000).

The third commonest cause of intestinal obstruction was bowel volvulus. The findings in this study compared well to other studies conducted in Nigeria(Lawal et al., 2005) where volvulus was the second commonest cause of intestinal obstruction with 15.2% and in a Tanzanian study (Chalya et al., 2014)where volvulus was third commonest cause of intestinal obstruction with 17%. Similarly, a study conducted in Pakistan(Asad et al., 2011) had volvulus as the third commonest cause of intestinal obstruction at 13.9%.An overwhelming majority of these bowel volvulus cases was among adults as shown in table 4.

The commonest site of volvulus was the sigmoid colon in line with many previous studies (Frazee et al., 1988; G. Jumbi & Kuremu, 2008; Kisa et al., 2009; Ooko et al., 2015; Roggo & Ottinger, 1992; Tumusiime et al., 2009; Ullah et al., 2011). Sigmoid volvulus has been shown as a common cause of intestinal obstruction in Africa and other developing counties (Bhuiyan et al., 2005; Jumbi, 2014; Khan et al., 2011; Muyembe & Suleman, 2000). Unlike what studies in developed countries show (Bhuiyan et al., 2005; Kahi & Rex, 2003), patients with sigmoid volvulus were relatively young and otherwise

healthy. This has been reported in other studies conducted in Africa (Bhuiyan et al., 2005; Nuhu & Jah, 2010; Oladele et al., 2008; Tumusiime et al., 2009).

This was followed by volvulus of the small bowel. Majority of these cases were primary, well in line with other studies(Demissie, 2001; Roggo & Ottinger,, 1992). There was only one case of caecal volvulus contrary to other studies(Frazee et al., 1988; Roggo & Ottinger, 1992) that show this site to be the second commonest site of the colon to be involved. In a study conducted in Tenwek in Kenya,(Ooko et al., 2015) sigmoid volvulus was the commonest cause if intestinal obstruction (25.6%) while small bowel and ileo-sigmoid volvulus constituted 21.3% and 8.5% respectively. As a single unified entity therefore, bowel volvulus constituted 55.4% of intestinal obstruction cases there, a figure much higher than the 17.1% in this study.

Intussusception was also noted to be a common cause of intestinal obstruction being the fourth commonest cause overall. Indeed, other authors had noted intussusception to be a common cause of intestinal obstruction especially in children (Ongom et al., 2014). The vast majority these patients were children and an overwhelming 83.3% was of the ileo-colic type which was similar to findings in other studies (Kuremu, 2004; Lawal et al., 2005; Ongom et al., 2014).

While hernia as a cause of intestinal obstruction was dominant in the past years, other causes of intestinal obstruction have come to take its place. This was reflected in this study where hernia contributed only 9.5% of the cases of intestinal obstruction with the majority being among adults. This reduced dominance of hernia is likely due to improved care of patients with hernia; with many being operated electively before they cause obstruction. This has been observed in many studies conducted in different parts of the world(Lawal et al., 2005; Oladele et al., 2008; Ooko et al., 2015). However, other

authors from developing countries still report hernia as the commonest cause of intestinal obstruction in their regions (Adesunkanmi et al., 2000; Ahmed et al., 2010; Chalya et al., 2014; Kadhim J. O. , 2011; Ntakiyiruta & Mukarugwiro, 2009; Qureshi & Khan, 2008; Souvik et al., 2010; Ullah et al., 2011).

Other causes of intestinal obstruction identified included tumours, TB of the abdomen and *Ascaris lumbricoides*. Other local and worldwide studies have reported similar results with regard to these 3 entities which are less common but important causes of intestinal obstruction (de Silva et al., 1997b; Kadhim J. O. , 2011; Ooko et al., 2015).

A study conducted in Nigeria revealed Ascaris as a cause of childhood intestinal obstruction in 0.77% of cases (Ogundoyin et al., 2009) which is comparable to this study's findings. This is likely due to widespread use of anti-helminthic drugs. However, in a study conducted by Lugaria at Litein hospital in Kenya, Ascaris caused 12% of intestinal obstruction cases and like in other studies, majority were children less than 10 years old(de Silva et al., 1997a; Lugaria, 2008). This was not different in this study where the only case of intestinal obstruction due to helminthiasis was in a child aged 4 years as illustrated in table 4.

In another study conducted in Tanzania, (Chalya et al., 2014) abdominal TB contributed 9.3% of intestinal obstruction causes, a figure much higher than the 0.5% found in this study. Parts of Asia report similar prevalence of abdominal TB as a cause of intestinal obstruction to that reported in the Tanzanian study (Asad et al., 2011; Qureshi & Khan, 2008; Souvik et al., 2010). As HIV infection rates rise in many developing countries, abdominal TB might re-emerge as a more dominant cause of intestinal obstruction (Khan et al., 2014; Souvik et al., 2010). Indeed, some studies conducted in Pakistan

revealed abdominal TB to be among the commonest causes of dynamic intestinal obstruction (Khan et al., 2014; Malik et al., 2010).

In this study the commonest site of obstruction was the small bowel with 63%. This is in line with other previously conducted studies (Maglinte et al., 2001; Malik et al., 2010; Ogundoyin et al., 2009).

Pattern of referral diagnoses

As shown in figure 3, the commonest cause of intestinal obstruction among those patients who presented directly from home was adhesions as compared to anorectal malformations among the referral patients. This is comparable to what was found in two different studies conducted in East Africa at referral hospitals. Researchers in Tenwek hospital in Bomet, Kenya, noted that the more likely reason for referral of cases was the need for operative intervention as compared to other causes of intestinal obstruction that could successfully be managed non-operatively at lower level hospitals (Ooko et al., 2015). Similar conclusions were reached in a study conducted in Mwanza, Tanzania (Chalya et al., 2014).

Treatment of intestinal obstruction at MTRH

Bowel decompression was done in patients with intestinal obstruction from the time the diagnosis was made. The mode of decompression was via NGT tube. None of the patients' NGT was adequately monitored and none had their tube actively managed throughout the time the tube was in place. Similar findings were highlighted in previous studies conducted at the MTRH (Kuremu & Jumbi, 2006). No patient was on long tube (naso-enteric) decompression likely due to unavailability of such tubes and inexperience with their use in our setting similar to what other authors noted (Maglinte et al., 2001).

In this study, fluid administration and monitoring was found to be a challenge as depicted by the significant deficits noted and illustrated in table 6. This was similar to

findings of previous studies conducted in the same hospital (Kuremu, 2004; Kuremu & Jumbi, 2006).

This study, like the ones conducted previously at the same hospital, demonstrates the urgent need to improve on fluid administration and monitoring in these patients with intestinal obstruction who present at different health facilities in Kenya including referral centers such as MTRH, even as they await surgery. The figures indicate the need to train ward staff, particularly the nurses on the importance of fluid resuscitation in patients with intestinal obstruction not only preoperatively but also post-operatively. The fact that surgery is not the end in these patient's care but only a step in that process must be emphasized to all who care for these patients.

Among the patients who were successfully managed non-operatively, majority were on one or more parenteral antimicrobial. Similarly, majority of those treated operatively received one or more parenteral antimicrobial before they were operated on. The antimicrobials given were aimed to cover against gram-negative and anaerobic bacteria which was in agreement with existing publications (Jackson & Raiji, 2011). The use of antimicrobials in patients with intestinal obstruction is consistent with literature that show bacterial overgrowth and translocation across the mucosa occurs in intestinal obstruction (Ezer et al., 2012; Hayanga et al., 2005).In this study though, use of these antimicrobials was not shown to reduce infective complications as shown in table 11. This is probably because the commonly used antimicrobials (ceftriaxone and metronidazole) were in widespread use in the hospital and the region and the choice of these drugs was not guided by known antimicrobial sensitivity patterns contrary to literature (Jackson & Raiji, 2011).

The success rate of conservative management in this study was 75% which was similar to success rates reported in various studies from all over the world (S.-C. Chen et al., 2005; Hayanga et al., 2005; Jackson & Raiji, 2011; Malik et al., 2010). In contrary however, other studies have reported much lower success rates of 15-45% with conservative management (Lawal et al., 2005; Oladele et al., 2008). This wide variation is likely to be due to differences in patient selection for conservative care. Indeed, factors like delayed presentation have been shown to predict conservative management failure (X.-L. Chen et al., 2012). Such factors may have influenced the lower success rates reported in these areas.

In this study the duration between admission to hospital and resolution of the intestinal obstruction (while on conservative treatment) or decision to abandon conservative management varied widely. However, the mean duration of such conservative management was within the largely acceptable duration of non-operative management of 3-5 days as depicted by various authors(S.-C. Chen et al., 2005; Di Saverio et al., 2013; Hayanga et al., 2005; Jackson & Raiji, 2011; Qureshi & Khan, 2008). Some patients were candidates for prolonged (more than 5 days) conservative management which is in agreement with literature (Di Saverio et al., 2013; Gong et al., 2013).

Similar to a study conducted in India(Souvik et al., 2010), the vast majority of intestinal obstructions patients underwent operations. All the patients in the operative group underwent open surgery largely due to limited laparoscopic facilities and the fact that many of the patients were very sick and unstable at presentation and could not be candidates for laparoscopic surgery. Minimally invasive surgery such as laparoscopic adhesiolysis may have a role (Di Saverio et al., 2013; Hayanga et al., 2005) and may minimise further adhesion formation together with lending the patient other benefits of laparoscopic surgery such as reduced post-operative pain.

Bowel strangulation

Among the patients who were treated operatively, 23% had gangrenous bowel. Similar bowel gangrene rates were reported from Tenwek hospital in Kenya(Ooko et al., 2015) and by Kuremu at the MTRH in a study evaluating childhood intussusceptions (Kuremu, 2004). Muyembe reported 32.4% rate of gangrene occurrence (Muyembe & Suleman, 2000). In a South African study, gangrene was found in 36% of sigmoid volvulus cases (Bhuiyan et al., 2005). Among all the intestinal obstruction cases though, the overall rate of gangrene was 19.2%.

This high rate of strangulation is in line with previously done studies that indicate delay in surgery more 24 hours after onset of illness lead to high chance of bowel resection as compared to when surgery is done within 12 hours of illness onset(Demissie, 2001; Di Saverio et al., 2013; Holcombe, 1995; Kadhim J. O. , 2011; Ntakiyiruta & Mukarugwiro, 2009; Qureshi & Khan, 2008; Roggo & Ottinger, 1992). Majority of our patients were operated >24 hours after illness onset. This was due to late presentation to hospital (as discussed earlier) similar to what other authors(Ahmed et al., 2010; Bhuiyan et al., 2005; Chalya et al., 2014; Malik et al., 2010; Nuhu & Jah, 2010) from developing countries have reported. With such high rates of bowel strangulation, open surgery may be recommended than laparoscopic approaches though there might be a role for exploratory laparoscopy (Di Saverio et al., 2013).

Various authors have tried to develop criteria for diagnosing bowel strangulation. Among the commonly cited parameters are fever, tachycardia, leucocytosis and localised abdominal tenderness (Hayanga et al., 2005; Kadhim J. O. , 2011; Kahi & Rex, 2003; Roggo & Ottinger, 1992; Stewardson et al., 1978). In this study (table 8), there was a statistically significant association between adult systolic blood pressure of less than 90mmHg at admission and presence of gangrenous bowel. In a study conducted in Muhimbili, Tanzania, all patients who had fever were found to have gangrene (Carneiro

& Kisusi, 2004). The differences in various studies illustrate the difficulties in diagnosing strangulation clinically by use of clinical or laboratory parameters. Indeed, many studies have emphasised on this point and there is consensus that no clinical or laboratory findings can rule out strangulation before surgery (Adesunkanmi et al., 2000; Di Saverio et al., 2013; Hayanga et al., 2005; Kadhim J. O. , 2011; Kahi & Rex, 2003; Roggo & Ottinger, 1992; Stewardson et al., 1978).

Among the patients with bowel gangrene, mojority underwent resection and primary anastomosis without on-table bowel lavage. It was common practice at the MTRH to perform resection and primary anastomosis in the setting of bowel gangrene and for other emergency bowel surgeries even when the left colon is involved. This was highlighted by Jumbi et al in their study on sigmoid volvulus at the MTRH (Jumbi & Kuremu, 2008) which showed similar outcomes in patients undergoing primary resection and anastomosis or colostomy fashioning even in the setting of gangrene. Similar practice was reported in a different hospital in Kenya (Ooko et al., 2015).

This practice is likely due to the negative attitude the Kenyan populace has towards stoma, unavailability of stoma care facilities (Jumbi & Kuremu, 2008) and limited accessibility to surgical services. This therefore compels the surgeons to opt for one-step surgical solutions for the patients with intestinal obstruction. Similar practices have been reported in other regions as well (Ahmed et al., 2010; Khan et al., 2011; Lawal et al., 2005; Marinis et al., 2009). In contrast though, other authors recommend bowel resection and stoma fashioning in similar circumstances (Bhuiyan et al., 2005; Kisa et al., 2009; Nuhu & Jah, 2010; Ongom et al., 2014).

Outcomes of intestinal obstruction management at MTRH

Morbidity: Complications

Complications were encountered in 23.6% of patients as illustrated in table 9. This is comparable to 21.7% found by Jumbi et al(G. Jumbi & Kuremu, 2008), 15% found at Tenwek hospital(Ooko et al., 2015) and 25.9% found in India(Souvik et al., 2010). The commonest complication was septicaemia followed by surgical site infection (SSI). Muyembe et al reported a rate of 14.4% for SSI (Muyembe & Suleman, 2000) and in a Nigerian study SSI was the commonest complication at 20.8% (Ogundoyin et al., 2009).

This high rate of infective complications correlates well with the high rate of bowel strangulation encountered in these patients. The presence of strangulation has been shown to increase morbidity in various studies (Hayanga et al., 2005; Ogundoyin et al., 2009; Ooko et al., 2015; Qureshi & Khan, 2008; Stewardson et al., 1978). Since bowel strangulation would be accompanied by bacterial translocation as highlighted by some authors (Ezer et al., 2012; Hayanga et al., 2005) or even overt contamination at surgery, then one might expect an increase in infective complications in these patients. An enterotomy, for example, in the setting of bowel resection has an attendant SSI rate of >50% (Stewardson et al., 1978). Contrary to expectations, the use of antimicrobials did not reduce the risk of infective complications as shown in table 11. This is probably due to the fact that the choice of antimicrobials was not guided by known sensitivity patterns.

Morbidity: Length of stay

The average length of hospitalization was comparable to findings in a study done in Litein, Kenya, (Lugaria, 2008) and another one in Tanzania (Chalya et al., 2014). Jumbi et al (Jumbi & Kuremu, 2008) found the mean length of stay among patients with sigmoid volvulus to be 11.8 days which is also comparable to this study.

In line with expectations, patients who had co-morbidities took a significantly longer duration in the hospital than those who did not have co-morbidities. Similarly, patients

who developed complications stayed significantly longer in the hospital. Similar results have been reported by other authors (Chalya et al., 2014).

Hospital mortality

The overall mortality rate in patients with intestinal obstruction at MTRH was comparable to 14% mortality in a study on childhood intussusception at the same hospital (Kuremu, 2004). Muyembe et al reported a mortality rate of 17.3% (Muyembe & Suleman, 2000) while in a Nigerian study, the mortality rate was 20%(Oladele et al., 2008). Another study also conducted in Nigeria (Lawal et al., 2005) among adult patients showed a hospital mortality was 14% which compares well with this study. Similar findings were reported in a study conducted in Tanzania, where the mortality rate was 14.3%, comparing well to the findings in this study (Chalya et al., 2014).

On the contrary however, a study conducted in Tenwek in Kenya reported a much lower hospital mortality of 4.5% despite similar rates of bowel gangrene. This was also the case in a different study conducted in Nigeria which revealed mortality of 3.1%. The significant differences in mortality rates among these studies despite similar rates of gangrene might be due to better post-operative care in those hospitals with better outcomes coupled with improved support services such as intensive care unit (ICU) and parenteral nutrition for the very sick patients.

Many studies have highlighted worse outcome in presence of gangrene (Demissie, 2001; Frazee et al., 1988). In a study conducted in Uganda, the presence of co-morbidity was also associated with high mortality (Kisa et al., 2009) similar to another study conducted in Boston in North America (Roggo & Ottinger, 1992). In this study, bowel gangrene significantly influenced development of complications and death. Similar findings were reported in another study conducted in Kenya (Ooko et al., 2015) among other studies (Adesunkanmi et al., 2000; Bhuiyan et al., 2005; Kahi & Rex, 2003; Lawal et al., 2005;

Oladele et al., 2008; Qureshi & Khan, 2008; Stewardson et al., 1978; Tumusiime et al., 2009). Some authors have reported doubling in mortality whenever bowel strangulation is encountered (Hayanga et al., 2005).

The leading cause of death was septicaemia, often accompanied by multiple organ failure. This has been reported as the commonest cause of death in patients with intestinal obstruction in different studies (Lawal et al., 2005; Souvik et al., 2010).The highest mortality was among patients in the 0-9 year age bracket. This is in agreement with Jumbi who noted that mortality was highest at extremes of ages(Jumbi, 2014). This is likely due to low immunity and physiological body reserves in the very young patients. In addition, our setting lacks TPN and paediatric ICU facilities and this may compound the problem among the very young patients who may need these facilities.

A high mortality rate of 50% was noted among patients with peritonitis and paralytic ileus. Both of these conditions are causes of adynamic intestinal obstruction. Another cause of intestinal obstruction with high mortality rate was bowel atresia with 40% mortality as shown in table 15. Such high mortality has been reported by some authors in contradistinction to survival rates of >90% in developed countries with adequate ICU and parenteral nutrition support (Millar et al., 2000).

CHAPTER SIX: CONCLUSIONS AND RECOMMENDATIONS

6.1. CONCLUSIONS

1. The common causes of intestinal obstruction in MTRH are adhesions, ARM, volvulus and intussusception

2. The mortality and morbidity rates from intestinal obstruction at the MTRH are similar to other hospital morbidity and mortality rates in the region and Africa

3. The single most important determinant of outcome in patients with intestinal obstruction is bowel gangrene.

6.2. RECOMMENDATIONS

1. Abdominal surgeries should be done meticulously (achieve absolute haemostasis, respect for tissues, wiping off glove powder) to reduce occurrence of adhesions

2. Early diagnosis of intestinal obstruction and special care for patients with bowel gangrene including critical care support (IVF, NGT, Antibiotics, Parenteral nutrition) is recommended

3. Strict adherence (by caregivers) to principles of fluid therapy and bowel decompression among patients with intestinal obstruction

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APPENDICES

APPENDIX 1: CONSENT FORM

PATTERN, MANAGEMENT AND OUTCOME OF INTESTINAL OBSTRUCTION AT THE MOI TEACHING AND REFERRAL HOSPITAL, ELDORET

INVESTIGATOR – DR. GACHINI JAMES M. OF P.O BOX 4606, ELDORET

I…….of P.O Box……

Tel……..hereby give informed consent to participate in this study in MTRH. The study has been explained to me clearly by Dr. GACHINI JAMES M. (or his appointed assistant) of P.O. Box 4606 Eldoret.

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

Name (initials) of participant……

Signature……

Date……

Name of witness……

Signature…….....

Date……

APPENDIX 2: QUESTIONNAIRE

PATTERN, MANAGEMENT AND OUTCOME OF INTESTINAL OBSTRUCTION AT THE MOI TEACHING AND REFERRAL HOSPITAL, ELDORET.

10 .DEMOGRAPHIC DATA

Patient's initials..... DoB..... Sex: male ☐ female ☐

Patient hospital number..... Tel…….

2.0 Determinants of outcome:

2.1. Co-morbidities: DM ☐ HTN ☐ Cardiac disease ☐ Others (specify)……..

2.2. ASA classification……..

2.3. Alcohol intake: Y/N. If yes, quantify……

2.4. Cigarette smoking: Y/N If yes, quantify…….

3.0. Prior history of abdominal surgery: Y/N

3.1. If yes, specify type and date of operation……..

4.0 Dominant signs and symptoms:

Pain ☐ Vomiting ☐ Abdominal distension ☐ Constipation ☐ Others.....

5.0 Duration between onset of symptoms and presentation to hospital (MTRH):

5.1 Patient direct from home.....

5.2 Referral from another health facility (specify facility)…….

6.0 vital signs (Normal or Abnormal):

PARAMETER	A/E(CASUALTY)	24HR OF ADM	PRE-OP (THEATER)	POST-OP (THEATER)	24HR AFTER THEATRE	DISCHARGE
BP						
PR						
TEMP						

7.0. Tests done to confirm/ support the diagnosis and findings:

TEST/ PARAMETER	**FINDINGS (state date)**	**NORMAL**	**FIINDINGS**	**NORMAL**	**FINDINGS**	**NORMAL**
AXR		Y / N		Y / N		Y / N
ABD. U/S		Y / N		Y / N		Y / N
Hb		Y / N		Y / N		Y / N
Hct		Y / N		Y / N		Y / N

WBC		Y / N		Y / N		Y / N
Plt		Y / N		Y / N		Y / N
Urea		Y / N		Y / N		Y / N
Creatinine		Y / N		Y / N		Y / N
Na+		Y / N		Y / N		Y / N
K+		Y / N		Y / N		Y / N
Others		Y / N		Y / N		Y / N
Others		Y / N		Y / N		Y / N

8.0 Preoperative diagnosis.....

9.0 Management offered: Conservative ☐ Operative ☐

9.1 If conservative:

9.1.1 Specify duration (up to resolution/improvement or decision to operate).....

9.1.2 Conservative treatment successful: Yes ☐ No ☐

9.2 What was the duration between admission and operation: .....

10.0 Adequacy of fluid resuscitation:

VOLUME OF IV FLUIDS GIVEN	**TYPE OF FLUID**	**PREOPERATIVE (**Average per day**)**	**POSTOPERATIVE (**Average per day**)**
	FREE WATER (dextrose)		
	CRYSTALLOIDS		
	COLLOIDS		
	BLOOD PRODUCTS		
	TOTAL		
URINE OUTPUT ADEQUATE		Y / N / Not monitored	Y / N / Not monitored

11.0 Any antibiotic given before surgery Yes ☐ No ☐

11.1 If yes to above, specify antibiotic(s).....

12.0 Intra-operative diagnosis.....

12.1 Procedure done.....

13.0 Any postoperative complications (Morbidity):

SURGICAL COMPLICATIONS *(tick as appropriate)*		**MEDICAL COMPLICATIONS** ***(****tick as appropriate****)***	
Wound sepsis		UTI	
Peritonitis/ Abscess		Pulmonary	
Gut necrosis		DVT	
Fistula Formation		Others (specify)	
Persistent ileus			
Others (specify			

14.0 Method and duration of bowel decompression:..... Has it been adequately and actively monitored.....

15.0 Eventual outcome:

ALIVE	ADMISSION DATE	
	DISCHARGE DATE	
DEAD	ADMISSION DATE	
	DATE OF DEATH	
	CAUSE OF DEATH	

APPENDIX 3: ASA CLASSIFICATION

ASA Class	Clinical state at the time of surgery
ASA I	Normally healthy patient
ASA II	Mild systemic disease
ASA III	Severe systemic disease that limits activity but not incapacitating
ASA IV	Incapacitating systemic disease which poses a constant threat to life
ASA V	Moribund: not expected to survive 24h even with operation
ASA VI	A declared brain dead patient whose organs are being removed for donor purposes

*A prefix E is used in emergencies.

APPENDIX 4: IREC FORMAL APPROVAL

INSTITUTIONAL RESEARCH AND ETHICS COMMITTEE (IREC)

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

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

Reference: IREC/2013/109
Approval Number: 0001052

3rd September, 2013

Dr. James Gachini,
Moi University,
School of Medicine,
P.O. Box 4606-30100,
ELDORET-KENYA.

Dear Dr. Gachini,

RE: FORMAL APPROVAL

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

"Patterns of Intestinal Obstruction and Management Outcome at Moi Teaching and Referral Hospital (MTRH), Eldoret"

Your proposal has been granted a Formal Approval Number: *FAN: IREC 1052* on 3rd September, 2013. You are therefore permitted to begin your investigations.

Note that this approval is for 1 year; it will thus expire on 2nd September, 2014. If it is necessary to continue with this research beyond the expiry date, a request for continuation should be made in writing to IREC Secretariat two months prior to the expiry date.

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

INSTITUTIONAL RESEARCH & ETHICS COMMITTEE
APPROVED
03 SEP 2013
P.O. Box 4606 ELDORET

Sincerely,

DR. W. ARUASA
DEPUTY - CHAIRMAN
INSTITUTIONAL RESEARCH AND ETHICS COMMITTEE

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

APPENDIX 5: IREC CONTINUING APPROVAL

INSTITUTIONAL RESEARCH AND ETHICS COMMITTEE (IREC)

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

MOI UNIVERSITY
SCHOOL OF MEDICINE
P.O. BOX 4606
ELDORET
Tel: 33471/2/3

Reference: IREC/2013/109
2013
Approval Number: 0001052

3rd September, 2014

Dr.Gachini James,
Moi University,
School of Medicine
P.O.Box 4606-30100
ELDORET-KENYA

INSTITUTIONAL RESEARCH & ETHICS COMMITTEE
03 SEP 2014
APPROVED
P.O. Box 4606-30100 ELDORET

Dear Dr.Gachini,

RE: CONTINUING APPROVAL

The Institutional Research and Ethics Committee has reviewed your request for continuing approval for your study titled:-

"Patterns of Intestinal Obstruction and Management Outcome at Moi Teaching and Referral Hospital (MTRH), Eldoret".

Your request has been granted Approval with effect from 3rd September, 2014. You are therefore permitted to continue with your study.

Note that this approval is for 1 year; it will thus expire on 2nd September, 2015. If it is necessary to continue with this research beyond the expiry date, a request for continuation should be made in writing to IREC Secretariat two months prior to the expiry date.

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

Sincerely,

PROF. E. WERE
CHAIRMAN
INSTITUTIONAL RESEARCH AND ETHICS COMMITTEE

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

APPENDIX 6: IREC APPROVAL OF AMENDMENT

INSTITUTIONAL RESEARCH AND ETHICS COMMITTEE (IREC)

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

MOIUNIVERSITY
SCHOOL OF MEDICINE
P.O. BOX 4606
ELDORET
Tel: 33471/2/3

Reference: IREC/2013/109
Approval Number: 0001052

2nd April, 2015

Dr. Gachini James,
Moi University,
School of Medicine,
P.O. Box 4606-30100,
ELDORET-KENYA.

INSTITUTIONAL RESEARCH & ETHICS COMMITTEE
02 APR 2015
APPROVED
P. O. Box 4606-30100 ELDORET

Dear Dr. Gachini,

RE: APPROVAL OF AMENDMENT

The Institutional Research and Ethics Committee has reviewed the amendment made to your proposal titled:-

"Patterns of Intestinal Obstruction and Management Outcome at Moi Teaching and Referral Hospital (MTRH), Eldoret".

We note that you are seeking to make an amendment as follows:-

- To make changes to your study title as follows ***"Pattern, Management and Outcome of Intestinal Obstruction at the Moi Teaching and Referral Hospital".***

The amendment has been approved on 2nd April, 2015 according to SOP's of IREC. You are therefore permitted to continue with your research.

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

Sincerely,

PROF. E. WERE
CHAIRMAN
INSTITUTIONAL RESEARCH AND ETHICS COMMITTEE

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

APPENDIX 7: MTRH APPROVAL

IREC/2013/109

MOI TEACHING AND REFERRAL HOSPITAL

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

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

3rd September, 2013

Dr. James Gachini,
Moi University,
School of Medicine,
P.O Box 4606-30100,
ELDORET-KENYA.

RE: APPROVAL TO CONDUCT RESEARCH AT MTRH

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

"Patterns of Intestinal Obstruction and Management outcome at Moi Teaching and Referral Hospital (MTRH), Eldoret".

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

DR. J. KIBOSIA
DIRECTOR
MOI TEACHING AND REFERRAL HOSPITAL

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