SURGICAL OUTCOMES OF MECHANICAL INTESTINAL OBSTRUCTION DUE TO NEOPLASMS AT MOI TEACHING AND REFERRAL HOSPITAL, ELDORET, KENYA.

BY

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THESIS SUBMITTED IN PARTIAL FULFILMENT FOR THE AWARD OF MASTER OF MEDICINE (GENERAL SURGERY) SCHOOL OF MEDICINE, MOI UNIVERSITY.

DECLARATION

Student's declaration

This research proposal is my original work done and has not been presented for the award of any degree in any university. I attest to the best of my knowledge, it contains no material previously published by another person, except where due acknowledgment has been made in the text.

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Supervisors' declaration

This research proposal has been submitted for examination with our approval as university supervisors.

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DEDICATION

I dedicate this work to the surgical patients with bowel obstruction due to neoplasms at Moi Teaching and Referral Hospital in Eldoret, Kenya for their interest and willingness to participate in this study. To my teachers and mentors, for their guidance and sacrifice in molding the kind of doctor I am today.

ABSTRACT

Background: Western Kenya have experienced increasing incidence of intestinal neoplasms. With high burden of the disease and limited resources, the morbidity and mortality rates are high. Therefore, there is need to assess the clinical presentation, surgery findings and interventions offered, postoperative complications and mortality rates associated with mechanical intestinal obstruction due to neoplasms.

Broad Objectives: To assess the surgical outcomes of mechanical intestinal obstruction due to neoplasms in adults at Moi Teaching and Referral Hospital, Eldoret, Kenya**.**

Methods: A prospective observational hospital-based study was carried out on 59 adult patients who presented with acute mechanical intestinal obstruction due to neoplasms undergoing laparotomy at Moi Teaching and Referral Hospital. All patients were recruited into the study from January to December 2023. The data collection form was used to collect the patients' demographic information, presenting signs and symptoms at the emergency department, intraoperative findings obtained, surgical interventions offered, postoperative complications, length of hospital stay and 30-day mortality rates. Categorical data was summarized as frequencies and their corresponding percentages while the numerical data was summarized as means and standard deviation. Bivariate analysis using Chi square /Fisher's exact tests and t- test/Mann Whitney U test were used to determine variable associations.

Results: Out of 59 study participants enrolled, 64.4% (n=38) were males and the average age of diagnosis was 51.4 years. Large bowel obstruction by neoplasm was more common than small bowel (72.9% vs 27.1%). In large bowel obstruction, the rectum (37.2%, n=16) and sigmoid colon (27.9%, n=12) were more commonly affected while in small bowel obstruction, the proximal ileum (43.7%, n=7) and duodenum (37.5%, n=6) were commonly affected. Adenocarcinoma was the commonest neoplasm causing small and large bowel obstruction (83.1%). The Tumor size (T) of T4 and T3 malignant neoplasms were more common accounting for 62.7%, n=37 and 20.3%, n=12 with nodal involvement (77.9%, n=46) and metastatic (57.6%, n=34). The surgical site infection (28.7%, n=29), electrolyte imbalance (23.8% n=24), and persistent ileus of >72 hours (19.8%, n=20) were the commonest postoperative complications encountered. The median length of hospital stay was 10 days. Grade 1 and 2 neoplasms and large bowel obstruction were associated with higher risk of complications and longer length of hospital stay (p value <0.001). The 30-day postoperative mortality rate for mechanical intestinal obstruction due to neoplasms was 10.8%.

Conclusion: Majority of the neoplasms causing acute mechanical intestinal obstruction in adults at MTRH were large bowel adenocarcinomas presenting at advanced stages and were associated with high post-surgery complication rates.

Recommendations: There is need to sensitize men and clinicians dealing with neoplasms causing mechanical intestinal obstruction at Moi Teaching and Referral Hospital in order to downstage the disease at presentation and improve early treatment outcomes.

Key words: Adults ,Mechanical intestinal obstruction, neoplasms, surgical outcome

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LIST OF ABBREVIATIONS

AJCC	American Joint Committee on Cancer
CRP	C reactive protein
CT	Computed Tomography
FIGO	Federation Internationale de Gynecologie et d'Obstetrique
GIST	Gastrointestinal Stromal Tumor
IF	Informed Consent
IO	Intestinal obstruction
IREC	Institutional Research and Ethics Committee
KS	Kaposi's' Sarcoma
LBO	Large Bowel Obstruction
LDH	Lactate Dehydrogenase
MBChB	Medicinae Baccalaureus, Baccalaureus Chirurgiae
MBO	Malignant Bowel Obstruction
MMED	Master of Medicine
MRI	Magnetic Resonance Imaging
MTRH	Moi Teaching and Referral Hospital
MU	Moi University
NACOSTI	National Commission for Science, Technology & Innovation
NET	Neuroendocrine tumor
OI	Opportunistic infection
PET	Positron emission tomography
S4A	Shoe for Africa
SBO	Small Bowel Obstruction
SD	Standard deviation
SSI	Surgical Site Infection
TNM	Tumor size, Nodal involvement, Metastasis
UICC	Union of International Cancer Control

DEFINITION OF TERMS

Acute intestinal obstruction	Failure of passage of bowel luminal contents in less than 7 days
Intestinal/bowel obstruction	Is the failure of passage of the intestinal luminal contents
Large bowel/intestine	Part of digestive system extending from ileocecal valve to anus
Mechanical intestinal obstruction	Physical barrier causing failure of passage on the intestinal luminal contents
Neoplasm:	An abnormal growth of tissue that can be benign, or malignant based on histological findings.
Small bowel/intestine	Part of digestive system located between pylorus and ileocecal valve
Surgical outcomes	Refers to the results or effects of a surgical procedure on a patient's health and well-being.

DISCLOSURE

There is no conflict of interest to declare in this study. The researcher did not receive any funding to carry out this work.

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CHAPTER ONE

1.1 INTRODUCTION

Intestinal obstruction (IO) is the failure of passage of the intestinal luminal contents. It can be classified according to pathology, anatomy, nature of presentation, and pathological changes in the bowel. According to pathology it can be dynamic (mechanical) where peristalsis is working against a mechanical obstruction or adynamic where there is no peristalsis in the absence of mechanical obstruction. By anatomical classification, it can be small or large bowel obstruction. Small bowel obstruction involves segment of the bowel distal to pylorus of the stomach up to the ileo-caecal junction while large bowel obstruction involves segment of the bowel from ileo-caecal junction to rectum. According to nature of presentation it can be acute (0-7 days), subacute (7-14 days) or chronic (>14 days). According to location in relation to the bowel wall, they can be classified as intraluminal where the neoplasms causing the obstruction projects into the lumen of the bowel or extra-luminal where the malignancy causing the compression of the bowel wall is located outside. Lastly by pathological changes it can be simple where the blood supply is intact or strangulated where the blood supply is compromised (Ooko, Sirera, Saruni, Topazian, & White, 2015; Winslet, Barraclough, & Campbell Hewson, 2021); Soressa et al., 2016a).

Acute mechanical IO is one of the most common causes of hospital visits at the emergency department worldwide. Neoplasms contribute to about 2-17% of the total mechanical obstructions worldwide. In a study done to determine the etiologies and outcomes of acute intestinal obstruction in Kumasi, Ghana, neoplasms accounted for 2.15% of the cases (Ohene-Yeboah, Adippah, & Gyasi-Sarpong, 2006). This compares with a similar study done in a rural hospital Northern Uganda, in which neoplasms

accounted for 3.8% of the cases (Okeny, Hwang, Ogwang, & Surgery, 2011). In Tenwek, Kenya, neoplasms accounted for 4.5% of all intestinal obstruction in 2015 (Ooko et al.). However, the rates of neoplasms causing mechanical IO have been shown to increase especially in the African continent. This is attributed to adoption of the western culture such as dietary changes which includes: increase in fatty foods and alcohol intake, and excessive smoking. Other factors such as lack of exercise, limited access to health facilities, low uptake of cancer screening services, inadequate workforce and health facilities providing cancer related services and low community awareness levels on malignant neoplasms have led to delayed diagnosis and treatment. Neoplasms causing mechanical bowel obstruction can be benign or malignant and can affect either small or large bowel. For small bowel, benign neoplasms include: adenomas, lipomas, fibromas, hamartomas and leiomyomas among others while the malignant neoplasms include: Adenocarcinomas, lymphomas, gastrointestinal stromal tumors, carcinoid tumors, sarcomas and peritoneal carcinomatosis due to gastric, colon and ovarian cancers among other causes. Benign neoplasms causing large bowel obstruction include: Lipomas, leiomyomas, polyps, Crohns colitis among others. The malignant neoplasms include: Adenocarcinomas, lymphomas, neuroendocrine tumors (carcinoid), and Kaposi sarcoma. Large bowel obstruction by the neoplasms is the commonest worldwide compared to small bowel obstruction. Malignancies causing mechanical bowel obstruction can be located within the abdomen (intra-abdominal) or outside the abdominal cavity (extra-abdominal). The most common intra-abdominal malignancies are those of the colon, ovary, stomach, pancreas, bladder and endometrium. Extra-abdominal malignancies likely to cause intestinal obstruction due to peritoneal involvement are those of the breast and melanomas (Tuca, Guell, Martinez-Losada, & Codorniu, 2012 & Codorniu, 2012 & Codorniu, 2012).

Adenocarcinomas are the most common primary malignant histological diagnoses made for both large and small bowel malignancies. They contribute to more than 75% of the total cases. Other histological subtypes include: lymphomas such as the Non-Hodgkins Lymphoma (NHL), neuroendocrine neoplasms, sarcomas, squamous cell carcinomas, gastrointestinal stromal tumors (GIST) among others (Markogiannakis et al.,2007; Cappel et al.,2008).

Intra -abdominal tumor growth may lead to mechanical obstruction either through extrinsic intestinal compression, endoluminal obstruction, intramural infiltration, or extensive mesenteric infiltration (Tuca et al., 2012). Patients will present with the cardinal signs and symptoms of intestinal obstruction such as the failure to pass stool and or flatus, abdominal pain and or distention, and vomiting. Additionally, they may have signs and symptoms depending on the location of the neoplasms and their metastatic site and substances secreted by the neoplasm such as rectal bleeding, anemia, diarrhea, respiratory complications among others. With prolonged obstruction, the patients develop bowel tissue ischemia which is associated with bowel infraction and perforation leading to development of peritonitis (Markogiannakis et al.,2007).

Simple radiological tests are useful for the diagnosis of mechanical intestinal obstruction such as the abdominal radiographs and ultrasound. Presence of bowel distention due trapped air and fluid proximal to the point of obstruction is revealed as multiple air-fluid levels which signify intestinal obstruction. Distal to the point of obstruction, the bowel is collapsed and does not show air-fluid levels. Use of oral contrast studies such as barium study series can help reveal the anatomical location of the obstruction such as the small or large bowel obstruction but their use is limited by patients' presenting symptoms such as nausea and vomiting. An abdominal ultrasound can be of great importance in the diagnosis of a mass causing the bowel obstruction. In

centers where computed tomography (CT) scans are available, their utilization with contrast is useful in further characterization of the mass and extend of the disease. However, their sensitivity and specificity reduce if the bowel neoplastic lesions are less than 0.5cm. In such cases, utilization of magnetic resonance imaging is useful due to its high sensitivity, specificity and predictive value than CT scan. This information is useful for the diagnosis, staging and treatment planning purposes to offer optimum treatment intervention (Tuca et al.).

Neoplasms causing complete mechanical IO have been demonstrated as a high-risk surgical emergency cases because of their association with high morbidity and mortality rates (Malik, Shah, Pathan, & Sufi, 2010). The treatment is individualized based on the patient factors such as physiological age, performance status, patient's wishes, presence of comorbidities; versus disease factors such as level of obstruction, number of occlusions i.e., single versus multiple, stage of the disease and aggressive nature of the malignancy. Surgery remains the mainstay treatment of choice to overcome the obstruction. There are various surgical options available depending on the extent of the neoplasms and associated complications. For localized neoplasms, resection and anastomosis is preferred to re-establish the continuity of the intestinal lumen. Other alternatives such as bypass surgery and stoma fashioning for stool diversion can be considered if the neoplasm is unresectable as part of palliative treatment. Additionally, these surgical options can be utilized single handedly or combined together to offer optimum treatment outcomes (Tuca et al., 2012). Usually, the emergency operations offered to this group of intestinal obstructions are often performed within 24 hours of the patient's admission or within 24 hours of the development of a specific complication (Catena et al., 2019).

The rate of post operative complications in acute mechanical IO due to neoplasms is high compared to surgeries due to other causes of intestinal obstruction. The rates are even higher in cases of the patients who are already diagnosed with intestinal malignant neoplasms and are undergoing cancer related treatment services. The rates of complications are influenced by several factors such as the patient's age, physical performance status, hemodynamic stability, stage of the neoplasms, tumor grade and level of contamination encountered during the surgery. The commonest post-surgery complications encountered in Low- and middle-income countries include surgical site infections, electrolyte imbalance, persistent ileus >72 hours, anemia and stoma related complications. The development of complications is associated with longer length of hospital stay which translates to high cost of treatment due to longer duration of hospitalization. The mortality rates are also high compared to other causes of mechanical intestinal obstruction. Low and middle income countries have higher rates compared to high income countries and this can be attributed to late stage of disease at presentation, inadequate cancer screening services and low uptake of such services by the surrounding communities, low awareness levels in among the healthcare workers and the general community, high cost of treatment, limited access to health facilities with capabilities of making such a diagnosis and delayed treatment (Ohene-Yeboah et al.,2006; Capona et al.,2021)

For the patients undergoing surgical intervention, age, stage of the neoplasm, nutritional status, and physical performance status of the patient determine the postoperative prognosis of the disease. Patients with age >65 years, advanced stage of malignancy at presentation, malnutrition indicated by hypoalbuminemia, presence of ascites and poor performance statuses conferred poor prognostication indicated by higher complication and mortality rates, longer duration of hospital stays and poor quality of life. The

patients with unresectable disease due to advanced malignancy tend to have an estimated mean survival rate no longer than 4 weeks (Tuca et al., 2012).

1.2 PROBLEM STATEMENT

The traditionally leading causes of acute mechanical intestinal obstruction include volvulus, adhesions and hernia worldwide. In Africa, there is a changing trend in which neoplasms are shown to be increasing and now among the top 3 causes of mechanical intestinal obstruction (Ohene-Yeboah et al.,2006). Colon cancer is the leading cause of large bowel obstruction while small bowel neoplasms are the third leading cause of small bowel obstruction after adhesions due to prior surgery and volvulus (Markogiannakis et al.,2007; Cappel et al.,2008) Mechanical intestinal obstruction is one of the leading reasons for patients visits to emergency department worldwide and neoplasms contribute to a significant proportion. Most of the patients with complete mechanical intestinal obstruction due to neoplasms, require surgery to re-establish the continuity of the intestinal lumen to alleviate the obstruction (Capona et al.,2021). The postoperative complications and mortality rates in patients who present with neoplasms as the cause of mechanical IO have been shown to be high despite relieving the obstruction by removing or bypassing the neoplasm. The high complication rates and advanced stage of neoplasms at presentation are associated with longer lengths of hospital stay. This translates to high cost of treatment that is associated with it (Cappel et al.,2008; Capona et al.,2021).

Currently there is limited data on acute mechanical intestinal obstruction due to neoplasms in our setup. The data provided by the hospital cancer registry does not provide information on surgical implications of these neoplasms causing mechanical intestinal obstruction (Chesumbai et al.,2024). The initial presentation stage, surgical

interventions offered, postoperative complications and mortality rates associated with these neoplasms are unknown in our setup.

1.3 JUSTIFICATION

Moi Teaching and Referral Hospital is a public, level VI tertiary institution which acts as a regional referral centre for western Kenya, eastern Uganda and South Sudan and Democratic Republic of Congo with a catchment population of about 25 million people. It houses the Eldoret Cancer Registry which contributes the cancer data to World Health Organization (MTRH, 2023; Chesumbai et al.,2024). Carrying out the study in this hospital will help reveal the surgical burden of neoplasms causing mechanical intestinal obstruction in Western Kenya.

The surgical interventions for bowel malignancies have evolved with increasing super specialization to enhance effective treatment that is precise and optimum in order to reduce the complication rates, and help improve quality of life with better survival rates. Surgical oncology is a new field in our set up and a practice that is gearing momentum in order to catch up with the rest of the world. With the advancement in practice in surgical oncology, it comes with advancement in technology and superior surgical techniques to alleviate the mechanical bowel obstruction (Ferreira et al.,2023). Such procedures are specified according to the magnitude of the problem or what is called the stage of the disease. The surgical magnitude of the bowel malignancies is not known in our set up hence this study will help investigate it.

Quantifying the magnitude of these neoplasms will provide a baseline knowledge on how big and relevant is the problem, interventions offered and treatment gaps if any and their treatment outcomes. The data obtained from this study will help formulate policies and interventions that will be geared towards improvement in surgical cascade

of patients presenting with mechanical intestinal obstruction due to neoplasms in our setup.

To my knowledge, this is the first prospective study to focus on neoplasm causing acute mechanical intestinal obstruction in small and large bowel in adults in our setup.

1.4 RESEARCH QUESTIONS

What are the surgical outcomes of mechanical intestinal obstruction due to neoplasms at Moi Teaching and Referral Hospital in Eldoret, Kenya?

1.5 OBJECTIVES

1.5.1 Broad Objective

To describe the surgical outcomes of mechanical intestinal obstruction due to neoplasms in adults at MTRH, Kenya.

1.5.2 Specific Objectives

1. To determine the social demographic characteristics of adult patients presenting with mechanical intestinal obstruction due to neoplasms at MTRH.
2. To describe the surgical findings of adult patients with mechanical intestinal obstruction due to neoplasms at MTRH.
3. To analyze the surgical interventions offered to adult patients with mechanical intestinal obstruction due to neoplasms at MTRH.
4. To describe the factors affecting early surgical treatment outcomes for mechanical intestinal obstruction due to neoplasms in adult patients at MTRH.

CHAPTER TWO

2.0 LITERATURE REVIEW

Neoplasms are among the most common causes of acute mechanical intestinal obstruction (IO) after sigmoid volvulus, adhesions, and hernia. The true prevalence of tumors causing mechanical IO is unknown but the range varies from 2-9% in Africa (Lawal et al., 2005; Riogi & Kennedy 2013). The picture is similar in the Kenyan setting where small and large bowel tumors are estimated to contribute to about 4.5% of mechanical IO (Ooko et al., 2015). The global prevalence varies from 2-17% with the large bowel obstruction being more common than the small bowel (Ohene-Yeboah 2006; Markogiannakis et al.,2007).

The presentation and management of mechanical intestinal obstruction due to neoplasms is dependent on the severity of the condition at the emergency department. In that regard, it can either be acute, sub-acute or chronic. When it is acute (less than 7 days), it usually presents with the classic features of mechanical intestinal obstruction such as vomiting, abdominal distention, and inability to pass stool (Cappell & Batke, 2008; Smith, Kashyap, & Nehring, 2022). However, it can as well be sub-acute (between 7-14 days) or chronic (more than 14 days), especially if the condition is recurring or is associated with resolving bouts of obstruction (Markogiannakis et al., 2007). Vomiting associated with mechanical intestinal obstruction is usually bilious and green colored though some argue that it can as well be yellow. Further, the author noted that green vomitus is a characteristic feature of obstruction that is distal to the ampulla of the vater, and immediate intervention is always advocated since it signals a red alarm. Vomiting in IO is associated with the depletion of the extracellular fluid due to over secretion of fluid from the obstructed bowel with compromised fluid and

electrolyte reabsorption, which is inconsistent with the secretion rate (Akrami et al., 2015; Cappell & Batke, 2008; Markogiannakis et al., 2007)

Abdominal distention is one of the most common presenting signs and symptoms of mechanical intestinal obstruction due to neoplasms and can either be mild, moderate or severe. In some cases, it can be absent especially in the cases of neoplasms causing proximal bowel obstruction. In these cases, the patients will present more with vomiting and abdominal pain rather than abdominal distention. As seen, the level of obstruction whether proximal or distal can have varied presentation. However, the presenting signs and symptoms can be misleading and are not specific to the etiological site of the mechanical bowel obstruction. (Frago et al., 2014; Ohene-Yeboah et al., 2006; Okeny et al., 2011).

The presentation of mechanical intestinal obstruction due to neoplasms emanates from the physical obstruction resulting into compromised bowel circulation due to congestion, translocation of normal gut flora to the bloodstream due to increased permeability of bowel wall and fluid and electrolyte imbalance due to fluid and electrolytes loss into the interstitial space. Failure to address these health concerns in a timely manner results in other emergency complications such as hypovolemic shock, renal and respiratory failure as well as sepsis (Cappell & Batke, 2008; Chaiyasate, Jain, Cheung, Jacobs, & Mittal, 2008; Jumbi et al., 2017). Sepsis can either be localized or generalized depending on the amount of the gut bacteria flora that has translocated from the gut into the bloodstream. Usually, this sepsis emanates from the overgrowth of the enteric bacteria as well as the release of endotoxins by the multiplied bacteria. Multiplication of bacteria usually results in the mesenteric nodes saturation, venules, and lymphatic injury and eventual penetration of the bacteria to the bowel wall amd

dissemination into the bloodstream leading to sepsis (Markogiannakis et al., 2007; Vallicelli et al., 2011).

The distention of the bowel in some instances results in increased intraluminal pressure that subsequently shuts blood away from the capillary bed and eventually leads to reduced arterial blood supply leading to ischemia and infarction of the bowel wall tissues. In these instances, mechanical intestinal obstruction can present with rectal bleeding after bowel ischemia and infarction. Some clinical presentation of IO such as tachycardia, fever and lethargy are usually a result of dehydration, sepsis, and fluid imbalance, which are the major health concerns associated with the condition (Chaiyasate et al., 2008; Markogiannakis et al., 2007)

Some clinical presentation features of mechanical intestinal obstruction associated with neoplasms are dependent on the location site of the obstruction. Features such as vomiting, abdominal pain and abdominal distention are more common in the acute setting for small bowel obstruction while the large bowel obstruction tend to present with delayed features of obstruction named above in addition to constipation and rectal bleeding (Jumbi et al., 2017; Markogiannakis et al., 2007; Vallicelli et al., 2011). However, these features are not specific to any anatomical site as the signs and symptoms can overlap for both mechanical small and large bowel obstructions (Ferguson, Ferguson, Speakman, & Ismail, 2015; Franke, Iqbal, Starr, Nair, & George Jr, 2017; Meyer et al., 2010; Wancata, Abdelsattar, Suwanabol, Campbell, & Hendren, 2017).

If no prompt intervention is instituted for mechanical bowel obstruction due to neoplasms, it can complicate leading to the dilation of the bowel proximal to the obstruction, interfere with intestinal integrity secondary to strangulation and

constriction of tissue blood supply as well as ischemia injury which may result to necrosis and in severe cases cause perforation leading to peritonitis which can either be an early or late presentation. The late neoplastic manifestation present with advanced features such as peritonei carcinomatosis along with other manifestations, such as the presence of bowel ischemia, necrosis and perforation, which are associated with high complication rates and mortality rates. (Ferguson et al., 2015; Jumbi et al., 2017; Markogiannakis et al., 2007)

2.1 Classification and aetiology of intestinal obstruction

Intestinal obstruction due to neoplasms contribute significantly to surgical emergencies across the world. However, the condition can be categorized into a variety of groups based on different variables. It can be classified according to ability to fully occlude the lumen, presence of a physical barrier which can be within the lumen (intraluminal) or outside the lumen (extraluminal), pathology, nature of presentation, impairment of blood supply, and anatomy (Winslet, Barraclough, & Campbell Hewson, 2021)

According to the capability to fully occlude the lumen, it can be partial or complete intestinal obstruction regarding their impediment to the flow of the bowel contents. Complete intestinal obstruction impedes the flow of content along the bowel lumen while partial allows some bowel contents to flow despite the presence of the obstruction (Cappel et al,. 2008)).

Pathological classification depends on the flow of luminal contents which can be impaired by the presence of a physical (mechanical) barrier or inactivity of the intestines due to paralysis (physiological). This causes dynamic and adynamic intestinal obstruction respectively. The significant difference between mechanical and physiological intestinal obstruction is that the former must be surgically corrected

through operation while the latter can be managed non-operatively through conservative treatment unless it is severe that may lead to complications. Further, both mechanical and physiological intestinal obstruction can occur concurrently in the same patient. Moreover, intestinal obstruction can be classified as either intraluminal or extra-luminal. Intraluminal is an intestinal obstruction that occurs within the lumen of the bowel such as obstruction caused by colonic neoplasm. In contrast, extra luminal obstruction is an obstruction that occurs outside the bowel of the lumen but applies pressure on the walls of the bowel lumen, which in turn interferes with the flow of bowel contents such as ovarian or uterine cancer compressing the colon (Tuca et al,. 2012)

The nature of presentation of intestinal obstruction is dependent on the duration since the onset, where it is categorized as either acute, sub-acute or chronic intestinal obstruction. In acute intestinal obstruction, the time duration is less than 7 days since the onset of development of the intestinal obstruction, while sub-acute is 7-14 days and chronic more than 14 days (Winslet, Barraclough, & Campbell Hewson, 2021)

Further, IO can be categorized as either simple or strangulating, depending on the compromise of blood supply. In simple intestinal obstruction, the blood supply is intact and may not lead to the development of bowel ischemia and, subsequently, infarction and bowel wall perforation. In strangulated intestinal obstruction, there is a compromise of the bowel blood supply, which eventually results in damage and death of cells and tissues leading to ischemia, necrosis and perforation (Capona et al. 2021).

Finally, intestinal obstruction can be categorized regarding the anatomical location of an obstruction within the bowel, which can be small bowel or large bowel obstruction. In small bowel obstruction, it involves impairment of luminal contents flow in any

section from the pylorus to ileo-caecal junction while in large bowel obstruction involves any section from ileo-caecal junction to the rectum. Additionally, small bowel obstruction can be classified according to the specific segment involved such as duodenum, jejunum, and ileum while large bowel obstruction can involve the caecum, ascending colon, right hepatic flexure, transverse colon, left splenic flexure, descending colon, sigmoid colon and the rectum. It is important to note that the bowel obstruction can involve more than one segment of the small and large bowel sections. According to the proximity to the ampulla of vater, the intestinal obstruction can be classified as proximal, mid, and distal intestinal obstruction. Proximal obstruction occurs just before or immediately after the ampulla of the vater while the mid and distal intestinal obstruction occurs at the jejunoileal and colon, respectively (Cappel et al,.2008; Capona et al,.2021; Winslet, Barraclough, & Campbell Hewson, 2021)

The etiological causes of intestinal obstruction can be broadly classified as either congenital or acquired causes. Congenital causes are developed during the intrauterine life or immediately after birth while acquired are developed later in life after birth. Congenital causes are the most prevalent in the pediatric population while acquired in adults. The most common causes of congenital intestinal obstruction in pediatrics include the following: malrotation, duodenal atresia, imperforate anus, Hirschsprung's disease, jejunoileal atresia, umbilical hernia among others. At the same time, acquired causes include intussusception, worm impaction, adhesive bowel obstruction, among others (Ohene-Yeboah et al,.2006; Malik et al,.2010). In adult population, congenital causes are rarely seen. The most common causes of acquired intestinal obstruction include the mechanical causes such as volvulus, adhesions, hernias, neoplasms, worms among others. Their prevalence varies worldwide. In western countries, adhesions are the leading cause of intestinal obstruction, volvulus in many African countries while

hernias in the most of the middle East countries. Unlike in the recent past, especially in African countries where worm impaction was among the significant causes of mechanical intestinal obstruction, there is a low incidence of worm impaction due to persistent utilization of anthelmintic agents in this region. (Ohene-Yeboah et al,.2006). In most parts of the world, there is reported increased incidence of neoplasms causing intestinal obstruction especially in Africa due to changes in dietary and adoption of sedentary lifestyles (Ohene-Yeboah et al,.2006; Malik et al,.2010).

2.1.1 Neoplasms causing mechanical intestinal obstruction

Neoplasms are among the most common causes of intestinal obstruction and particularly mechanical intestinal obstruction. The classification system follows that of intestinal obstruction as discussed above in addition to being benign or malignant neoplastic causes of intestinal obstruction. Benign neoplasms are non-cancerous lesion while malignant neoplasms are cancerous lesions in the small and large bowel that can cause an acute, sub-acute or chronic intestinal obstruction (Smith et al,.2022). In most cases when discussing about neoplastic causes of intestinal obstruction, it is assumed that the referred pathology here is the malignant or cancerous neoplasms. In such cases, men are more affected compared to their female counterparts (Cappel et al,.2008). In this study, mechanical intestinal obstruction solely due to neoplasms will be focused on.

2.2 Diagnosis

The diagnosis of mechanical intestinal obstruction is arrived at after a thorough, comprehensive history, physical examination, laboratory investigations, and radiological imaging. Comprehensive history involves elucidating the cardinal symptoms of IO, such as vomiting, abdominal pain, failure to pass stool among other symptoms such as pain, fever and diarrhea. The color of the vomitus is noted since

green and yellow vomitus is indicative of intestinal obstruction, especially mechanical obstruction (Cappel et al,.2008; Capona et al,.2021)

Laboratory investigations such as complete blood count, serum electrolyte levels and blood urea nitrogen are ordered to check for complications and presentation of intestinal obstruction. In the presence of IO, these investigations may indicate leukocytosis, elevated hematocrit, raised BUN, and metabolic alkalosis or acidosis. Blood culture is used to investigate the presence of septicemia since pathology tends to allow the bacteria to translocate from the gut to the bloodstream. Bowel ischemia can be diagnosed with the aid of laboratory investigations, whereby its presence is marked with elevated serum amylase, hyperkalemia, and lactic acidosis (Cappel et al,.2008)).

Radiological images are usually indicated to aid in the diagnosis of intestinal and also to establish the etiological cause and complications associated with it. An abdominal radiograph can show multiple air fluid levels, distended bowel loops, air under right diaphragm in case of bowel perforation and a lack of gas in the distal loop of the bowel to signify collapse due to proximal obstruction. Another radiological study is the use of contrast and radiographs in the upper gastrointestinal series (Cappel et al,.2008). In this imaging study, a contrast is utilized to mainly diagnose proximal obstruction. Barium contrast is the preferable medium since it gives good contrast images, it is cheap as well as readily available (Cappel et al,.2008).

Ultrasound of the abdomen is mainly indicated when identifying etiological agents such as extra-luminal masses like tumors causing mechanical IO. It is also useful when diagnosing conditions such as masses, as well as in the observation of blood flow to the bowel. Ultrasound is usually preferred due to its high sensitivity and specificity and is also used as an alternative when radiations are contraindicated (Tamburrini et al.,2019).

Image studies like the use of CT scan of the abdomen are indicated to detect the causes of mechanical intestinal obstruction such as tumors. Furthermore, a CT scan provides a clear picture of the bowel and substance collection within the lumen of the bowel. A CT scan could be combined with a contrast to make a confirmation of IO causes (Furukawa et al.,2003; Horton et al.,2004). Endoscopy has also been utilized in both sub-acute and chronic intestine obstruction to identify the etiological agent of intestinal obstruction (Pujahari 2016). A study done by (Capona et al.,2021) pointed out that prompt diagnosis and immediate interventions result in improved outcomes.

2.3 Staging

The small and large bowel neoplasms that are considered malignant are staged for treatment and prognostication purposes. The American Joint Committee on Cancer (AJCC) together with the Union for International Cancer Control (UICC) have come up with a standardized staging system recognized globally for malignant neoplasms in which they use size of the tumor (T), nodal involvement (N), and level of metastasis (M) to form the TNM staging system. With this system the patients are staged similarly worldwide and the surgeons and other allied medical professionals are able to speak the same language in terms of staging and treatment purposes (AJCC, 2017). The TNM staging is discussed below in the subsequent sub headings.

2.3.1. Small bowel malignant neoplasms

Small bowel forms about 90% of the total surface area of gastrointestinal tract but malignancy arising from it comprise of <5% of all GIT malignancies. They include: Adenocarcinomas, lymphomas, neuroendocrine tumors, gastrointestinal tumors (GIST), and sarcomas (Roth et al. 2014). The staging systems are utilized according to the different histologic subtypes. In this section, the various staging systems for each histological subtype will be discussed.

Adenocarcinomas are the most common diagnosed histologic subtype for small bowel malignant neoplasms (Roth et al.,2014). They are staged according to the 8th edition of American Joint Committee on Cancer (AJCC) classification which utilizes the Tumor size, Nodal involvement and Metastasize system (TNM) as highlighted in the table below:

Table 1: TNM staging of small bowel adenocarcinoma (Coig et al.,2017)

Primary tumor (T)	
T category	T criteria
TX	Primary tumor cannot be assessed
T0	No evidence of primary tumor
Tis	High-grade dysplasia/carcinoma *in situ*
T1	Tumor invades the lamina propria or submucosa
T1a	Tumor invades the lamina propria
T1b	Tumor invades the submucosa
T2	Tumor invades the muscularis propria
T3	Tumor invades through the muscularis propria into the subserosa, or extends into nonperitonealized perimuscular tissue (mesentery or retroperitoneum) without serosal penetration*
T4	Tumor perforates the visceral peritoneum or directly invades other organs or structures (eg, other loops of

	small intestine, mesentery of adjacent loops of bowel, and abdominal wall by way of serosa; for duodenum only, invasion of pancreas or bile duct)
Regional lymph nodes (N)	
N category	**N criteria**
NX	Regional lymph nodes cannot be assessed
N0	No regional lymph node metastasis
N1	Metastasis in one or two regional lymph nodes
N2	Metastasis in three or more regional lymph nodes
Distant metastasis (M)	
M category	**M criteria**
M0	No distant metastasis
M1	Distant metastasis present

The TNM staging is used for prognostication purposes where the following staging groups are obtained as listed below.

Table 2: Group stages of small bowel adenocarcinomas (Coig et al.,2017)

Prognostic stage groups			
Adenocarcinoma			
When T is…	**And N is…**	**And M is…**	**Then the stage group is…**
Tis	N0	M0	0
T1-2	N0	M0	I
T3	N0	M0	IIA
T4	N0	M0	IIB
Any T	N1	M0	IIIA
Any T	N2	M0	IIIB
Any T	Any N	M1	IV
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According to (Aparicio et al 2013), small bowel adenocarcinomas generally had a poor prognosis but it varied according to the stage. The 5-year overall survival rate was 14-33%, but according to the specific stage, for stage I was 50-60%, stage II 39-55%, stage III 10-40% and stage IV 3-5%. Other factors such as the advanced age of the patients, the anatomical location of the neoplasms such as ileum and duodenum, the presence of lymphovascular invasion, the post-surgical positive margins, recovery of less than 10 lymph nodes during surgery, histological grade of poorly differentiated malignancies, and the number of nodes found to be invaded by the malignancy contributed to the poor overall survival rate.

Lymphomas also contributed significantly to the composition of small bowel malignancies. They contribute to about 20-30% of all gastrointestinal lymphomas. For localized disease, surgery is the mainstay treatment of choice. However, combined treatment modality with chemotherapy have been shown to have better overall survival. In this case, a multidisciplinary team composed of surgeons, gastroenterologists and haemato-oncologists is recommended for better treatment outcomes (Barsouk et al.,2019). For prognostication several factors have been shown to contribute to mortality prediction. They include: stage of lymphoma, response to treatment, symptomatology of the disease, mode of presentation, type of lymphoma, ability to cause anemia, level of albumin, LDH, and CRP. Lymphomas with extra nodal involvement, not responding to chemotherapy, with abdominal symptoms and causing anaemia, low albumin and elevated levels of LDH and CRP are associated with poor prognosis (Michael et al.,2023). Additionally, B cell type lymphomas, occurring in the acute setting, and in elderly patients have been shown to have overall poor prognosis. As illustrated, staging plays a critical role in the management and prognostication of lymphomas. The Lugano classification system is the updated version of Ann Arbor classification used for staging lymphomas. This system utilizes two variables, that is the number and anatomical location of the lymph node involved which can be nodal or extra nodal.as depicted in the table below (Michael et al.,2023)

Table 3: Revised staging system for primary nodal lymphomas (Lugano classification) Michael et al.,2023

Stage	Involvement	Extra nodal status
Limited		
I	One node or a group of adjacent nodes	Single extra nodal lesions without nodal involvement
II	Two or more nodal groups on the same side of the diaphragm	Stage I or II by nodal extent with limited contiguous extra nodal involvement
II bulky*	II as above with "bulky" disease	Not applicable
Advanced		
III	Nodes on both sides of the diaphragm; nodes above the diaphragm with spleen involvement	Not applicable
IV	Additional noncontiguous extra lymphatic involvement	Not applicable
Extent of disease is determined by positron emission tomography/computed tomography (PET/CT) for avid lymphomas and CT for nonavid histologies . Tonsils, Waldeyer's ring, and spleen are considered nodal tissue.		
* Whether stage II bulky disease is treated as limited or advanced disease may be determined by histology and a number of prognostic factors.		
From: Cheson BD, Fisher RI, Barrington SF, et al. Recommendations for initial evaluation, staging, and response assessment of Hodgkin and non-Hodgkin lymphoma: The Lugano classification. J Clin Oncol 2014; 32(27):3059-67. Reprinted with permission. Copyright © 2014 American Society of Clinical Oncology. All rights reserved		

Most of the small bowel lymphomas are either diagnosed early or late therefore necessitating high index of suspicion to make an early diagnosis. The stage I disease contributes to about (42.5%) of all small bowel lymphomas, stage II (12.5%), and stage III (5%). The stage IV disease also contributes significantly to about 40% of the cases. As seen stage I and IV contributes to over 80% of the cases forming the foundation and need for multidisciplinary approach in their management (Dias et al 2023).

The soft tissue sarcomas of the small bowel are rare and contribute to about 10% of all small bowel malignancies (Howe et al. 2001) Several factors have been shown to

contribute to overall mortality rate and disease specific survival. The tumor size more than 5cm, other histologic subtype other than leiomyosarcoma, and advanced stage of the disease at diagnosis are poor prognostic markers for 5-year disease specific survival in patients with small bowel sarcomas. The staging of soft tissue sarcomas of the small bowel utilizes the TNM staging as per the 8th edition of American Joint Committee on Cancer (AJCC) soft tissue sarcoma staging system which stages patients into 4 categories outlined as stage I to IV depending on the size of the tumor, presence or absence of nodal involvement and level of distant metastases (Michael et al.,2023). This is as outlined below:

Table 4: Visceral soft tissue sarcomas that originate from abdominal TNM staging according to the AJCC UICC 8th edition

Primary tumor (T)	
T category	**T criteria**
TX	Primary tumor cannot be assessed
T1	Organ confined
T2	Tumor extension into tissue beyond organ
T2a	Invades serosa or visceral peritoneum
T2b	Extension beyond serosa (mesentery)
T3	Invades another organ
T4	Multifocal involvement
T4a	Multifocal (two sites)
T4b	Multifocal (three to five sites)
T4c	Multifocal (>5 sites)
Regional lymph nodes (N)	
N category	**N criteria**
N0	No lymph node involvement or unknown lymph node status
N1	Lymph node involvement present
Distant metastasis (M)	
M category	**M criteria**
M0	No metastases
M1	Metastases present
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Gastrointestinal Stromal Tumors (GIST) of the small bowel contribute to about 30% of all gastrointestinal tract GIST tumors. Their treatment is primarily based on the stage of the disease. Surgery forms the main treatment modality for the cases of localized disease. The extent of the disease coverage is based on tumor size, nodal involvement and extent of metastases which forms the basis of TNM staging according to the 8th edition of AJCC classification system as follows (Michael et al.,2023):

Table 5: The TNM staging of the Gastrointestinal Stromal Tumor (GIST)

Primary tumor (T)	
T category	**T criteria**
TX	Primary tumor cannot be assessed
T0	No evidence of primary tumor
T1	Tumor 2 cm or less
T2	Tumor more than 2 cm but not more than 5 cm
T3	Tumor more than 5 cm but not more than 10 cm
T4	Tumor more than 10 cm in greatest dimension
Regional lymph nodes (N)	
N category	**N criteria**
N0	No regional lymph node metastasis or unknown lymph node status
N1	Regional lymph node metastasis
Distant metastasis (M)	
M category	**M criteria**
M0	No distant metastasis
M1	Distant metastasis
Mitotic rate	
Mitotic rate	**Definition**
Low	Five or fewer mitoses per 5 mm^2
High	Over five mitoses per 5 mm^2

The gastrointestinal tumors of the small bowel have unpredictable biological pattern. Their prognostication factors are dependent on the size of the tumor and the count of the mitoses. Due to their rarity to involve the locoregional lymph nodes, radical surgical procedures form the main surgical management of the disease. The medical therapy involving drug therapy such as Imatinib is utilized in the post-surgery setting or in cases

where the disease is unresectable (Wu et al.,2006). The prognostication stage groups follow the above highlighted parameters of tumor size, nodal involvement, distant metastases and mitotic rates as follows (Michael et al.,2023):

Table 6: The group stages for Gastrointestinal Tumor of the small bowel

Prognostic stage groups				
Small intestinal, esophageal, colorectal, mesenteric, and peritoneal GIST				
When T is…	**And N is…**	**And M is…**	**And mitotic rate is…**	**Then the stage group is…**
T1 or T2	N0	M0	Low	I
T3	N0	M0	Low	II
T1	N0	M0	High	IIIA
T4	N0	M0	Low	IIIA
T2	N0	M0	High	IIIB
T3	N0	M0	High	IIIB
T4	N0	M0	High	IIIB
Any T	N1	M0	Any rate	IV
Any T	Any N	M1	Any rate	IV
GIST: gastrointestinal stromal tumor; TNM: tumor, node, metastasis; AJCC: American Joint Committee on Cancer; UICC: Union for International Cancer Control				
Used with permission of the American College of Surgeons, Chicago, Illinois. The original source for this information is the AJCC Cancer Staging Manual, Eighth Edition (2017) published by Springer International Publishing. Corrected at 4th printing, 2018.				

The small bowel neuroendocrine tumors are the second most common cause of small bowel malignancies after adenocarcinomas contributing to about 40% of the cases. They contribute significantly to morbidity and mortality associated with small bowel malignancies. Most of the malignancies are diagnosed late and tend to have liver metastases at the time of disease presentation (Scott &Howe 2020). The extent of radical resection of the neoplasm is largely depended on the stage of the disease which is derived from tumor size, the extent of nodal involvement and distant metastases. The neuroendocrine tumors of small bowel utilize the TNM staging and are categorized whether if they involve the duodenum and the sphincter of Oddi and the tumors

involving the jejunum and ileum. The TNM staging used for neuroendocrine tumors arising from the duodenum and ampulla of vater are classified as shown in the table below (Michael et al.,2023).

Table 7: The TNM staging of Neuroendocrine tumors of the duodenum and ampulla

Primary tumor (T)	
T category	**T criteria**
TX	Primary tumor cannot be assessed
T1	Tumor invades the mucosa or submucosa only and is ≤1 cm (duodenal tumors). Tumor ≤1 cm and confined within the sphincter of Oddi (ampullary tumors).
T2	Tumor invades the muscularis propria or is >1 cm (duodenal). Tumor invades through sphincter into duodenal submucosa or muscularis propria, or is >1 cm (ampullary).
T3	Tumor invades the pancreas or peripancreatic adipose tissue
T4	Tumor invades the visceral peritoneum (serosa) or other organs
Regional lymph nodes (N)	
N category	**N criteria**
NX	Regional lymph nodes cannot be assessed
N0	No regional lymph node involvement
N1	Regional lymph node involvement
NOTE: Multiple tumors should be designated as such (and the largest tumor should be used to assign the T category): ▪ If the number of tumors is known, use T(#); eg, pT3(4) N0 M0. ▪ If the number of tumors is unavailable or too numerous, use the m suffix, T(m); eg, pT3(m) N0 M0.	
M category	**M criteria**
M0	No distant metastasis
M1	Distant metastases
M1a	Metastasis confined to liver
M1b	Metastases in at least one extrahepatic site (eg, lung, ovary, nonregional lymph node, peritoneum, bone)
M1c	Both hepatic and extrahepatic metastases

Table 8: The Prognostic group stages of the duodenal and ampullary Neuroendocrine tumors (Michael et al.,2023

Prognostic stage groups			
When T is…	**And N is…**	**And M is…**	**Then the stage group is…**
T1	N0	M0	I
T2	N0	M0	II
T3	N0	M0	II
T4	N0	M0	III
Any T	N1	M0	III
Any T	Any N	M1	IV
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The small bowel neuroendocrine tumors involving the jejunum and the ileum are also staged using the TNM staging system but have different tumor descriptions as compared to that of duodenum and sphincter of Oddi. They are classified as follows:

Table 9: Neuroendocrine tumors of the jejunum and ileum TNM staging AJCC UICC 8th edition (Michael et al.,2023)

Primary tumor (T)	
T category	**T criteria**
TX	Primary tumor cannot be assessed
T0	No evidence of primary tumor
T1*	Invades lamina propria or submucosa and less than or equal to 1 cm in size
T2*	Invades muscularis propria or greater than 1 cm in size
T3*	Invades through the muscularis propria into subserosal tissue without penetration of overlying serosa
* NOTE: For any T, add (m) for multiple tumors [TX(#) or TX(m), where X = 1 to 4, and # = number of primary tumors identified¶]; for multiple tumors with different T, use the highest. Example: If there are two primary tumors, only one of which invades through the muscularis propria into subserosal tissue without penetration of overlying serosa (jejunal or ileal), we define the primary tumor as either T3(2) or T3(m).	
Regional lymph nodes (N)	
N category	**N criteria**
NX	Regional lymph nodes cannot be assessed
N0	No regional lymph node metastasis has occurred

N1	Regional lymph node metastasis less than 12 nodes
N2	Large mesenteric masses (>2 cm) and/or extensive nodal deposits (12 or greater), especially those that encase the superior mesenteric vessels
Distant metastasis (M)	
M category	**M criteria**
M0	No distant metastasis
M1	Distant metastasis
M1a	Metastasis confined to liver
M1b	Metastases in at least one extrahepatic site (eg, lung, ovary, nonregional lymph node, peritoneum, bone)
M1c	Both hepatic and extrahepatic metastases

Table 10: The prognostication group stages of the duodenal and ampullary neuroendocrine tumors (Michael et al.,2023

Prognostic stage groups			
When T is…	**And N is…**	**And M is…**	**Then the stage group is…**
TX, T0	NX, N0, N1, N2	M1	IV
T1	N0	M0	I
T1	N1, N2	M0	III
T1	NX, N0, N1, N2	M1	IV
T2	N0	M0	II
T2	N1, N2	M0	III
T2	NX, N0, N1, N2	M1	IV
T3	N0	M0	II
T3	NX, N0, N1, N2	M1	IV
T4	N0	M0	III
T4	N1, N2	M0	III
T4	NX, N0, N1, N2	M1	IV
For multiple synchronous tumors, the highest T category should be used and the multiplicity or the number of tumors should be indicated in parenthesis: eg, T3(2) or T3(m).			
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The overall survival rates of small bowel neuroendocrine tumors vary according to stage which is categorized as localized (Stage I and II), regional (stage III), and distant metastatic (stage IV) diseases. The 5-year survival rate for the disease is 67.6% and for

localized disease 85%, regional 74.6% and distant metastases 42.1% (Barsouk et al.,2019).

2.3.2. Large bowel malignant neoplasms

The malignant neoplasms that can cause large bowel obstruction present as masses which can be intraluminal or extraluminal. Also, they can present as primary neoplasms meaning that they arise from large bowel or secondary colonic masses which arise from somewhere else to involve the colon. Primary large bowel neoplasms which are located intraluminal are composed of adenocarcinomas (majority), lymphomas, neuroendocrine tumors, and Kaposi Sarcoma. The extraluminal masses affecting the large bowel commonly arise from the ovary, prostate and uterus which can overgrow to cause large bowel obstruction (Rawla et al.,2019). In this section both intraluminal and extraluminal causes of large bowel obstruction due to neoplasms will be discussed. Their staging systems and prognostication are discussed as below.

The adenocarcinoma of colon is the most common cause of large bowel neoplasms and the leading cause of large bowel obstruction due to neoplasms. It is staged according to the size of the tumor (T), status of nodal involvement (N) and the extent of distant metastases (M) which comprises the TNM staging according to the 8th edition by the American Joint Committee on Cancer (AJCC). The staging is as shown in the below (Jessup et al.,2017):

Table 11: The TNM staging of the colon adenocarcinomas

Primary tumor (T)	
T category	**T criteria**
TX	Primary tumor cannot be assessed
T0	No evidence of primary tumor
Tis	Carcinoma *in situ*, intramucosal carcinoma (involvement of lamina propria with no extension through muscularis mucosae)
T1	Tumor invades the submucosa (through the muscularis mucosa but not into the muscularis propria)
T2	Tumor invades the muscularis propria
T3	Tumor invades through the muscularis propria into pericolorectal tissues
T4	Tumor invades* the visceral peritoneum or invades or adheres¶ to adjacent organ or structure
T4a	Tumor invades* through the visceral peritoneum (including gross perforation of the bowel through tumor and continuous invasion of tumor through areas of inflammation to the surface of the visceral peritoneum)
* Direct invasion in T4 includes invasion of other organs or other segments of the colorectum as a result of direct extension through the serosa, as confirmed on microscopic examination (for example, invasion of the sigmoid colon by a carcinoma of the cecum) or, for cancers in a retroperitoneal or subperitoneal location, direct invasion of other organs or structures by virtue of extension beyond the muscularis propria (ie, respectively, a tumor on the posterior wall of the descending colon invading the left kidney or lateral abdominal wall; or a mid or distal rectal cancer with invasion of prostate, seminal vesicles, cervix, or vagina). Tumor that is adherent to other organs or structures, grossly, is classified cT4b. However, if no tumor is present in the adhesion, microscopically, the classification should be pT1-4a depending on the anatomical depth of wall invasion. The V and L classification should be used to identify the presence or absence of vascular or lymphatic invasion whereas the PN prognostic factor should be used for perineural invasion.	
Regional lymph nodes (N)	
N category	**N criteria**
NX	Regional lymph nodes cannot be assessed
N0	No regional lymph node metastasis
N1	One to three regional lymph nodes are positive (tumor in lymph nodes measuring ≥0.2 mm), or any number of

	tumor deposits are present and all identifiable lymph nodes are negative
N1a	One regional lymph node is positive
N1b	Two or three regional lymph nodes are positive
N1c	No regional lymph nodes are positive, but there are tumor deposits in the: ▪ Subserosa ▪ Mesentery Nonperitonealized pericolic, or perirectal/mesorectal tissues
N2	Four or more regional nodes are positive
N2a	Four to six regional lymph nodes are positive
N2b	Seven or more regional lymph nodes are positive
Distant metastasis (M)	
M category	**M criteria**
M0	No distant metastasis by imaging, etc; no evidence of tumor in distant sites or organs. (This category is not assigned by pathologists.)
M1	Metastasis to one or more distant sites or organs or peritoneal metastasis is identified
M1a	Metastasis to one site or organ is identified without peritoneal metastasis
M1b	Metastasis to two or more sites or organs is identified without peritoneal metastasis
M1c	Metastasis to the peritoneal surface is identified alone or with other site or organ metastases

The TNM staging system is further broken down into four stages I to IV which are used to plan for treatment and also for prognostication purposes as shown in the table below (Jessup et al.,2017).

Table 12: The group stages of the colon adenocarcinomas

Tis	N0	M0	0
T1, T2	N0	M0	I
T3	N0	M0	IIA
T4a	N0	M0	IIB
T4b	N0	M0	IIC
T1-T2	N1/N1c	M0	IIIA
T1	N2a	M0	IIIA
T3-T4a	N1/N1c	M0	IIIB
T2-T3	N2a	M0	IIIB
T1-T2	N2b	M0	IIIB
T4a	N2a	M0	IIIC
T3-T4a	N2b	M0	IIIC
T4b	N1-N2	M0	IIIC
Any T	Any N	M1a	IVA
Any T	Any N	M1b	IVB
Any T	Any N	M1c	IVC

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The TNM staging forms one of the major prognostication indicators of the disease overall survival. In the US, the 5-year relative survival rate in patients with stage one colon adenocarcinoma is approximately 92%. For stage IIA is 87% while for stage II B is 65%. Interestingly, the 5-year survival rate seen in stage IIIA and IIIB are a little bit higher accounting for about 90% and 72% respectively. As for the stage IIIC the relative survival rate reduces to 53%. The metastatic stage or stage IV, has the poorest 5-year survival rate of about 12% (Rawla et al 2019).

Kaposi sarcoma

The Kaposi sarcoma can cause large bowel obstruction due to luminal occupying lesion or when acting as a lead point to cause intussusception. It is one of the common causes of intestinal obstruction especially in the people living with HIV/AIDS and have their immune status compromised. The AIDS clinical trials group (ACTG) classified Kaposi

sarcoma according to the Tumor (T), Immune status (I), and Systemic illness (S) Staging system for AIDS-related KS as outlined in the table below (Krown et al.,1997)

Table 13: The staging of HIV/AIDS related Kaposi Sarcoma

	Good risk (all of the following)	**Poor risk (any of the following)**
Tumor, T	T0: Confined to skin and/or lymph nodes and/or minimal oral disease (non-nodular KS confined to palate)	T1: Tumor-associated edema or ulceration Extensive oral KS Gastrointestinal KS KS in other non-nodal viscera
Immune system, I	I0: CD4 cell count >200/μL*	I1: CD4 cell count <200/μL
Systemic illness, S	S0: No history of OI or thrush No "B" symptoms Karnofsky performance status >70	S1: History of OI and/or thrush "B" symptoms present Karnofsky performance status <70 Other HIV-related illness (eg, neurologic disease, lymphoma)
KS: Kaposi sarcoma; OI: opportunistic infection. * A CD4 lymphocyte cut-off of 150 μL may be more discriminatory. (Krown, SE, Testa, MA, Huang, J. AIDS-related Kaposi's sarcoma: prospective validation of the AIDS Clinical Trials Group staging classification. AIDS Clinical Trials Group Oncology Committee. J Clin Oncol 1997; 15:3085.) "B" symptoms are unexplained fever, night sweats, >10% involuntary weight loss, or diarrhea persisting more than two weeks.		
Adapted from: Krown, SE, Metroka, C, Wernz, JC. Kaposi's sarcoma in the acquired immune deficiency syndrome: a proposal for uniform evaluation, response, and staging criteria. AIDS Clinical Trials Group Oncology Committee. J Clin Oncol 1989; 7:1201		

Ovarian cancer

Primary ovarian cancers are one of leading causing of extraluminal causes of mechanical large bowel obstruction due to their ability to cause extensive growths arising from the pelvis to put a compression pressure and or involve the colon in the abdomen. Its staging utilizes the tumor size (T), Nodal involvement (N), and extent of distant Metastases (TNM) staging system to group the ovarian cancer into 4 prognostic stages according to the 8th edition, American Joint Committee on cancer and Union for International Cancer Control (AJCC/UICC) classification system as outlined in the table below (Prat et al.,2017).

Table 14: The TNM and FIGO classification system of ovarian cancer

Primary tumor (T)		
T category	**FIGO stage**	**T criteria**
TX		Primary tumor cannot be assessed
T0		No evidence of primary tumor
T1	I	Tumor limited to ovaries (one or both) or fallopian tube(s)
T1a	IA	Tumor limited to one ovary (capsule intact) or fallopian tube, no tumor on ovarian or fallopian tube surface; no malignant cells in ascites or peritoneal washings
T1b	IB	Tumor limited to both ovaries (capsules intact) or fallopian tubes; no tumor on ovarian or fallopian tube surface; no malignant cells in ascites or peritoneal washings
T1c	IC	Tumor limited to one or both ovaries or fallopian

		tubes, with any of the following:
T1c1	IC1	Surgical spill
T1c2	IC2	Capsule ruptured before surgery or tumor on ovarian or fallopian tube surface
T1c3	IC3	Malignant cells in ascites or peritoneal washings
T2	II	Tumor involves one or both ovaries or fallopian tubes with pelvic extension below pelvic brim or primary peritoneal cancer
T2a	IIA	Extension and/or implants on the uterus and/or fallopian tube(s) and/or ovaries
T2b	IIB	Extension to and/or implants on other pelvic tissues
T3	III	Tumor involves one or both ovaries or fallopian tubes, or primary peritoneal cancer, with microscopically confirmed peritoneal metastasis outside the pelvis and/or metastasis to the retroperitoneal (pelvic and/or para-aortic) lymph nodes
T3a	IIIA2	Microscopic extra pelvic (above the pelvic brim) peritoneal involvement with or without positive retroperitoneal lymph nodes
T3b	IIIB	Macroscopic peritoneal metastasis beyond pelvis 2 cm or less in greatest dimension with or without metastasis to the retroperitoneal lymph nodes
T3c	IIIC	Macroscopic peritoneal metastasis beyond the

		pelvis more than 2 cm in greatest dimension with or without metastasis to the retroperitoneal lymph nodes (includes extension of tumor to capsule of liver and spleen without parenchymal involvement of either organ)
Regional lymph nodes (N)		
NX		Regional lymph node cannot be assessed
N0		No regional lymph node Metastasis
N0(i+)		Isolated tumor cells in regional lymph nodes <0.2mm
N1	IIIA1	Positive (histologically confirmed) retroperitoneal lymph nodes.
N1a	IIIA1i	Metastasis less than 10 mm in greatest dimension
N1b	IIIA1ii	Metastasis more than 10 mm in greatest dimension
Distant metastasis (M)		
M category	**FIGO stage**	**M criteria**
M0		No distant metastasis
M1	IV	Distant metastasis, including pleural effusion with positive cytology; liver or splenic parenchymal metastasis; metastasis to extra-abdominal organs (including inguinal lymph nodes and lymph nodes outside the abdominal cavity); and transmural involvement of intestine
M1a	IVA	Pleural effusion with positive cytology
M1b	IVB	Liver or splenic parenchymal metastases; metastases to extra-

		abdominal organs (including inguinal lymph nodes and lymph nodes outside the abdominal cavity); transmural involvement of intestine

Table 15: The summarized group stages of the ovarian cancer (Prat et al.,2017*)*

When T is…	**And N is…**	**And M is…**	**Then the stage group is…**
T1	N0	M0	I
T1a	N0	M0	IA
T1b	N0	M0	IB
T1c	N0	M0	IC
T2	N0	M0	II
T2a	N0	M0	IIA
T2b	N0	M0	IIB
T1/T2	N1	M0	IIIA1
T3a	NX, N0, N1	M0	IIIA2
T3b	NX, N0, N1	M0	IIIB
T3c	NX, N0, N1	M0	IIIC
Any T	Any N	M1	IV
Any T	Any N	M1a	IVA
Any T	Any N	M1b	IVB
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Corpus uteri carcinoma

The malignant neoplasms arising from the uterus are also a major cause of extraluminal cause of mechanical large bowel obstruction from the neoplasms arising from the pelvis. It utilizes the TNM staging which is combined with the FIGO classification system as outlined below (Richard et al.,2022):

Table 16: The combined TNM staging AJCC UICC 8th edition and FIGO classification system for Corpus uteri carcinoma and carcinosarcoma

The definitions of the T categories correspond to the stages accepted by the Fédération Internationale de Gynécologie et d'Obstétrique (FIGO). Both systems are included for comparison.		
Primary tumor (T)		
T category	**FIGO stage**	**T criteria**
TX		Primary tumor cannot be assessed
T0		No evidence of primary tumor
T1	I	Tumor confined to the corpus uteri, including endocervical glandular involvement
T1a	IA	Tumor limited to the endometrium or invading less than half the myometrium
T1b	IB	Tumor invading one half or more of the myometrium
T2	II	Tumor invading the stromal connective tissue of the cervix but not extending beyond the uterus. Does NOT include endocervical glandular involvement.
T3	III	Tumor involving serosa, adnexa, vagina, or parametrium
T3a	IIIA	Tumor involving the serosa and/or adnexa (direct extension or metastasis)
T3b	IIIB	Vaginal involvement (direct extension or metastasis) or parametrial involvement
T4	IVA	Tumor invading the bladder mucosa and/or bowel mucosa (bullous edema is not sufficient to classify a tumor as T4)
T suffix (m) if synchronous primary tumors are found in a single organ.		
Regional lymph nodes (N)		
N category	**FIGO stage**	**N criteria**

NX		Regional lymph nodes cannot be assessed
N0		No regional lymph node metastasis
N0(i+)		Isolated tumor cells in regional lymph node(s) no greater than 0.2 mm
N1	IIIC1	Regional lymph node metastasis to pelvic lymph nodes
N1mi	IIIC1	Regional lymph node metastasis (greater than 0.2 mm but not greater than 2.0 mm in diameter) to pelvic lymph nodes
N1a	IIIC1	Regional lymph node metastasis (greater than 2.0 mm in diameter) to pelvic lymph nodes
N2	IIIC2	Regional lymph node metastasis to para-aortic lymph nodes, with or without positive pelvic lymph nodes
N2mi	IIIC2	Regional lymph node metastasis (greater than 0.2 mm but not greater than 2.0 mm in diameter) to para-aortic lymph nodes, with or without positive pelvic lymph nodes
N2a	IIIC2	Regional lymph node metastasis (greater than 2.0 mm in diameter) to para-aortic lymph nodes, with or without positive pelvic lymph nodes
Suffix (sn) is added to the N category when regional lymph node metastasis is identified by sentinel lymph node biopsy only. **Suffix (f) is added to the N category when metastasis is identified by fine needle aspiration (FNA) or core needle biopsy only.**		
Distant metastasis (M)		
M category	**FIGO stage**	**M criteria**
cM0		No distant metastasis
cM1	IVB	Distant metastasis (includes to inguinal lymph nodes, intraperitoneal

		disease, lung, liver, or bone). (It excludes metastasis to pelvic or para-aortic lymph nodes, vagina, uterine serosa, or adnexa.)
pM1	IVB	Distant metastasis (includes to inguinal lymph nodes, intraperitoneal disease, liver, or bone) microscopically confirmed. (It excludes metastasis to pelvic or para-aortic lymph nodes, vagina, uterine serosa, or adnexa.)

The TNM staging system is used to derive 4 staging groups of carcinoma/ carcinosarcoma of corpus uteri (Richard et al.,2022). The treatment and prognosis are based on the stage as outlined below.

Table 17: The group stages of corpus uteri carcinoma/ carcinosarcoma

Prognostic stage groups			
When T is…	**And N is…**	**And M is…**	**Then the stage group is…**
T1	N0	M0	I
T1a	N0	M0	IA
T1b	N0	M0	IB
T2	N0	M0	II
T3	N0	M0	III
T3a	N0	M0	IIIA
T3b	N0	M0	IIIB
T1-T3	N1/N1mi/N1a	M0	IIIC1
T1-T3	N2/N2mi/N2a	M0	IIIC2
T4	Any N	M0	IVA
Any T	Any N	M1	IVB

2.4 Treatment

The management of mechanical IO due to neoplasms is effective when the patient is collaboratively managed by a multi-disciplinary team that includes surgeons, oncology, nutritionist, and nurse, among others (Tenge-Kuremu et al., 2007; Capona et al,.2021). Usually, prompt diagnosis and immediate intervention are associated with improved treatment outcomes of intestinal obstruction. Treatment can either be a surgical operation or non-surgical treatment that is conservative (Capona et al.,2021). The primary focus in the management of this condition is to provide initial resuscitation by decompressing the bowel via the nasogastric tube, maintain fluid and electrolyte balance as well as administer antibiotics prophylactically (Cappel et al.,2008, Capona et al.,2021).

Fluid resuscitation usually involves administration of intravenous fluids since the patient is kept nil per oral. The fluid is given to maintain hydration due to fluid loss associated with vomiting as well as to prevent the addition of fluid in the gastrointestinal tract (Cappel et al.,2008). If a patient presents with hypovolemic shock secondary to intestinal obstruction, fluid resuscitation is recommended to maintain blood pressure and ensure perfusion to the vital body organs. For obstructions distal to the ligament of Treitz, ringers lactate solution is recommended for resuscitation. Moreover, colloids such as albumin can be used in cases where bowel obstruction results in protein losses. The colloids are aimed at increasing the vascular bed oncotic pressure. Usually, vascular access is fundamental in ensuring the proper administration of intravenous fluids, medications, and minimize the risk of aspiration during immediate resuscitation (Capona et al.,2021).

Bowel decompression with the aid of a nasogastric tube to allow for drainage of the aspiration as well as decreased diaphragm movement restriction help relieve signs and

symptoms associated with IO. Nasogastric/oral gastric insertion should be carefully done to prevent lung aspiration and risks of emesis (Capona et al 2021). Another management is ensuring adequate energy source as it aid in maintaining homeostatic glucose level. This is because the patient can experience hypoglycemia due to dehydration and inadequate fluid intake though they can also experience hyperglycemia secondary to stress response related to intestinal obstruction and sepsis (Cappel et al.,2008)

Antibiotics are ordered for prophylaxis since most patients present with abdominal distention as well as some have the potential for translocation of bacteria from the gut to the bloodstream. Broad-spectrum antibiotics with both anaerobic and aerobic coverage are recommended for this condition. Surgery is the most preferred intervention for mechanical. Usually, preoperatively the patient is prepared by taking a comprehensive history, blood type, complete blood count, and coagulation profile. Further, in the preoperative phase, fluid resuscitation and correction of fluid and electrolyte imbalance are significant before proceeding to the surgical operation (Markogiannakis et al., 2007; Capona et al.,2021).

Various forms of surgical interventions are indicated depending on the etiological cause, and among the most frequent surgeries include bowel resection and anastomosis, herniotomy, colostomy, among others (Caldas et al. 2023; Markogiannakis et al. 2007). It is known that post-operative management and nursing care are fundamental for the successful recovery of patients following emergency surgery (Capona et al,.2021). However, the post-operative period could be characterized by significant complications such as surgical site infection, wound dehiscence, fecal fistula, and sepsis. Most of these complications are associated with high morbidity and mortality (Markogiannakis et al., 2007; Krouse et al., 2017). Meticulous resuscitation and efficient conservative

management preoperatively is associated with decreased morbidity and mortality secondary to mechanical intestinal obstruction. In most developing countries however, these intestinal obstruction emergency surgeries are complicated and problematic to perform as well as they are associated with high chances of mortality. This has been attributed to inadequate resources, lack of equipped surgical facilities, and surgeons (Ohene-Yeboah et al.,2006; Okeny et al.,2011).

Recent studies from some developed countries indicate that surgeries have improved outcome due to improved funding of healthcare, coordinated surgical care, increased collaboration with international countries as well as increased understanding of surgeries in these countries. Conservative management has been linked with reduced hospital stay and a lack of post-operative complications such as adhesions (Cappel et al.,2008). However, it does not eliminate the cause of obstructions and has a high probability of recurrence and readmissions to the facility. Besides, there is a delay for surgery, which eventually may lead to increased IO morbidity and mortality (Capona et al., 2021).

For patients presenting with mechanical intestinal obstruction due to neoplasms are offered different surgical options depending on the extent of the disease and level of obstruction. For complete intestinal obstruction, immediate surgical interventions should be sought out to relieve the obstruction and aver the danger of likely perforation which can be fatal. The surgical options include: Resection and anastomosis for neoplasms that can be removed safely, bypass surgery especially in small bowel neoplasms and fecal diversion through stoma creation for unresectable disease. Resection and anastomosis surgical option if feasible usually offers longer survival rates (Markogiannakis et al., 2007; Caldas et al. 2023).

2.5 Prognosis

Prognosis of mechanical IO due to neoplasms can either be good or poor and is dependent on several determinants such as length of hospital stay, management intervention ensued, the presence of any associated complications and stage of the disease at presentation ((Paul et al., 2022; Wancata et al., 2017). The worst prognosis is usually seen when the surgical intervention of intestinal obstruction results in severe post-operative complications such as sepsis, perforation of the bowel, and enterocolitis. Late presentation of symptoms is correlated with adverse health outcomes that eventually lead to poor disease prognosis (Ferguson et al., 2015; Markogiannakis et al., 2007). The advanced stage of the neoplasm at presentation is associated with poor prognosis. For example: The 5-year survival rate of small bowel malignant neoplasms in the US as reported by AJCC 2017, for stage I is 70%, II-55%, III-30%, and IV-5-10%. The more advanced stage at presentation, the poorer the survival outcomes.

Most patients with intestinal obstruction managed in most developing countries may have a poor outcome, unlike their counterparts in developed countries such as the USA. This disparity has been linked to developed systems, resources and well-developed surgical emergency facilities in the developed countries (Wancata, 2017; Wright, 2019). Other determinants such as the absence of trained personnel, financial constraints, delayed presentation, high complication rates and advanced stage of the disease at presentation are associated with poor prognosis, and this usually occurs in most developing countries (Okeny, 2011; Ohene-Yeboah, 2006; Nakaganda, 2021; Chalya, 2013; Ekenze et al., 2016). The anatomical location of the bowel obstruction by the neoplasms also has an implication on the overall prognosis on the affected patients. Small bowel obstruction has been shown to have poorer prognosis when compared to large bowel obstruction. This is alluded to lack of authenticated cancer

screening modality for small bowel malignancy as compared to large bowel. (Chaiyasate et al., 2008)

The postoperative complication rates are usually high in patients with mechanical intestinal obstruction due to neoplasms after undergoing surgery due to the weakened immune status, poor nutrition and physical performance status. The most common complications include: Surgical site infection, electrolyte imbalance, prolonged ileus for more than 72 hours, anemia, stoma related complications among others. Attention is usually given to these patients in order to promptly recognize and manage these complications (Markogiannakis et al., 2007; Caldas et al.,2023)

The mortality rates in patients with mechanical intestinal obstruction due to neoplasms are high when compared to normal population reaching up to 30%. The most cause of the high mortality rate is sepsis that arises during the postoperative period due to high surgical infection rates. Renal failure, and respiratory failure also contribute to a significant percentage in such kind of patients (Krouse et al., 2017; Caldas et al.,2023)

CHAPTER THREE

3.0 METHODOLOGY

3.1 Study site

The study was conducted at the Moi Teaching and Referral Hospital. It is a level VI, second largest national referral hospital located in Eldoret, Kenya. It has a bed capacity of about 1,020 and catchment area of about 25 million people. The hospital serves as a regional referral centre for the western part of Kenya, Easten Uganda, South Sudan and Democratic Republic of Congo.It has 5 theatres with 12 operating rooms namely Majaliwa, Neuro, Shoe4Africa and Riley Mother and Baby Hospital theatres. The surgeries of patients with mechanical intestinal obstruction due to neoplasms can be done in any of the 5 theatres. After surgery, they can be admitted in general or private surgical wards for recovery until discharge. The general wards include: Kilimanjaro (for adult males) and Rehema wards (for adult females). The private wards include amenity and memorial wards (contain private rooms in which individual patients can be admitted) (MTRH, 2022).

3.2 Study design

Prospective observational study. Participants were consecutively recruited into the study after undergoing surgery in surgical wards until sample size was reached. They were then followed up at 2 and 4 weeks respectively after discharge.

3.3 Study period

January to December 2023.

3.4 Study population

Participants aged 18 years and above diagnosed with intestinal obstruction secondary to neoplasms at Moi Teaching and Referral Hospital.

3.5 Eligibility Criteria

3.5.1 Inclusion criteria

i. Participant aged 18 years and above at the time of signing the informed consent
ii. Participants undergoing laparotomy to relieve the mechanical intestinal obstruction
iii. Participant with intraoperative findings of neoplasms causing mechanical intestinal obstruction.

3.5.2 Exclusion criteria

i. Participants with incomplete information such as the intraoperative finding or staging information
ii. Participants with prior confirmatory histological diagnosis of malignant neoplasms causing mechanical intestinal obstruction and has received any form of treatment targeting the neoplasm.

3.6 Sample size

A total of 59 study participants were included in the study. However, in order to determine the minimum sample size needed determine the surgical outcomes of the mechanical intestinal obstruction due to neoplasms at MTRH, modified Cochrane's formula was used to determine the sample size for the finite population. The modified Cochrane's formula was derived from the Cochranes formula to adjust for finite study population as follows:

$$n_o = \frac{Z^2pq}{e^2}$$

Where:

n_o = Desired original sample size

z= z-value at 95% Confidence Interval (1.96)

p= proportion of neoplasms causing acute intestinal obstruction requiring laparotomy in adults (11.0 % from previous data at MTRH)

q= 1-p (0.89)

e= margin of error (5%).

Substituting: $\frac{(0.11*0.89)1.96^2}{0.0025}$ = 150.4 (150 participants).

Since the study population was less than 10,000, the modified Cochrane's formula was used to determine the desired sample size as follows:

n= desired sample size (N<10,000) i.e study population less than 10,000

$$n = \frac{n_0}{1 + \frac{(n_0 - 1)}{N}}$$

n= The desired sample size calculated previously (150)

N= Total study population (<10,000)

As per the MTRH general surgery theatre records, an average of 65 laparotomies of mechanical intestinal obstruction due to neoplasms were done between 2021 and 2022 that is N=65.

Therefore,

$$n = \frac{150}{1 + (150-1)/65}$$

n=46 participants

Adjusting for non-response by 15% gave sample size of 53 participants. The number of study participants exceeded the minimum sample size required. Therefore, the results were considered representative.

3.7 Sampling technique

Census sampling was done to include all patients who presented with mechanical intestinal obstruction due to neoplasms from January to December 2023

3.8 Study Procedure

Participants recruited into the study were identified through checking the general surgery register daily in theatre and daily nursing register (A book where all surgeries done and patients are entered) in Kilimanjaro and Rehema wards. The participants were then subjected to consenting process which was administered by the research assistant. Assessment of comprehension of the consent by asking verbal questions on what consent form entailed was done by research assistant. Clarification was made on questions that were not understood and repeat of sections not understood was also be done until comprehension was achieved. This was followed by signing of the consent form by those literate (able to read and write) or fingerprint (not able to read and write). A witness was used for those not able to read and write. After the consent, demographic information was obtained from the participant and file retrieved to check the intraoperative findings and intervention offered for the intestinal obstruction while in theatre. At discharge the file was also retrieved to check for the complications experienced by the patient during the admission period and length of hospital stay. At 30^{th} day post-surgery, patients were called by phone to assess whether they had healed completely from surgery and if there were any cancer treatment they had received since discharge. This information was collected, coded and presented for analysis.

3.9 Recruitment strategy

All patients aged 18 years and above with mechanical intestinal obstruction due to neoplasms admitted at MTRH Kilimanjaro, Rehema and amenity wards after undergoing surgery were recruited into the study by the research assistant. They were identified through daily review of the general surgery register in theater and some by

daily inspection of the nursing register in the respective wards. After identification, they were subjected to consenting process, and recruited into the study by the research assistant.

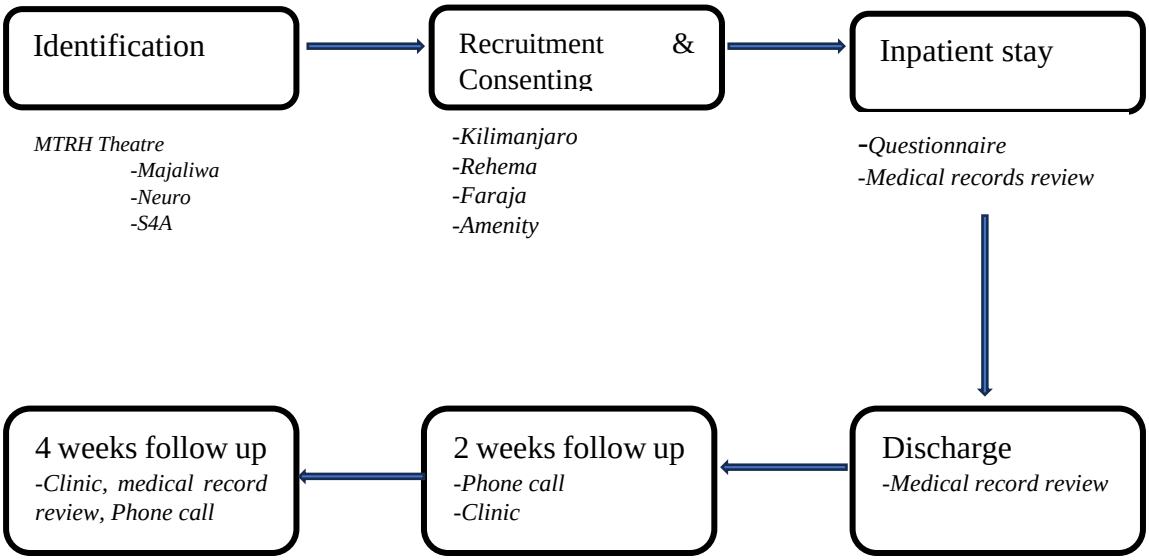

Figure 1: Study participant recruitment schema

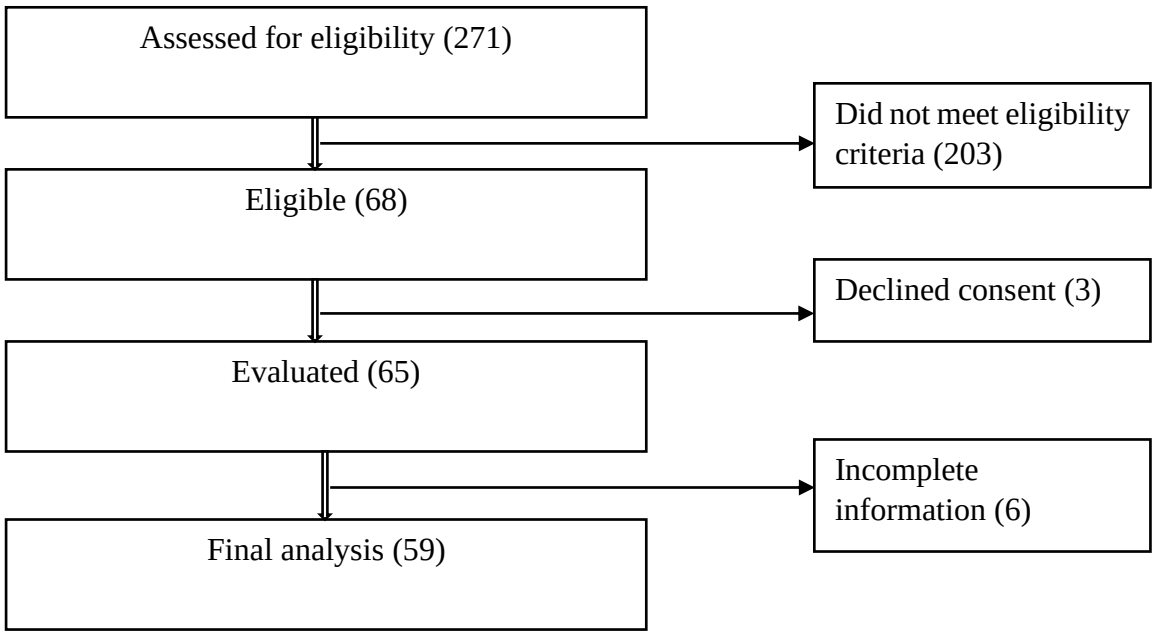

Figure 2: The reasons for exclusion of study participants

Out of 271 participants who underwent surgery due to intestinal obstruction, only 68 were attributed to neoplasms after subjecting them to inclusion criteria. Three study participants declined to participate in the study by refusing to sign the informed consent. They feared the diagnosis of cancer which was associated with bad omen. The 6 participants did not have histological diagnosis of their neoplasms and the staging information was missing. Their diagnoses depended on the clinical judgement. Therefore it was difficult to know whether they had benign o malignant neoplasms.

3.10 Data Analysis Techniques

Preliminary analysis involved a summary of study participants' demographic characteristics. Where categorical variables such as sex, and marital status, were summarized as frequencies and their corresponding percentages. While numerical variables such as age, were summarized using means and their corresponding standard deviation. Further analysis was done per the objectives as summarized below:

For objectives one, two and three, univariate analysis was done where categorical data such as nodal involvement, metastasis, presenting symptoms, pathological features, intra operative findings and intervention offered were summarized as frequencies and their corresponding percentages.

To answer objective four, categorical variables such as complications, resumption of normal duty, and linkage to oncology clinic were summarized as frequencies and their corresponding percentages at univariate level. While length of stay was summarized as median and its corresponding interquartile range. We also assessed the association between surgical complications and demographic and clinical characteristics of the patients at bivariate level. Where Chi square /Fisher's exact tests were used to assess association between categorical variables such gender and site of obstruction with development of complication. While t- test/Mann Whitney U test were used to compare the average age and length of hospital stay between those who developed complications and those who didn't.

The study findings were presented using figures, tables, and graphs. All the test results were considered statistically significant if p- value was less than 0.05.

3.11 Ethical Considerations

Ethical approval was obtained from the Institutional Research and Ethics Committee (IREC) of Moi University and Moi Teaching and Referral Hospital **(IREC No.0004325)**, the MTRH management **(Ref: ELD/MTRH/R&P/10/2/V.2/2010)** and NACOSTI **(License No: 329487)** prior to study commencement . Informed consent was obtained from all potential study participants prior to enrollment. Participant's data were de-identified and given study numbers, kept in key and lock cabinets accessible to only study staff to ensure privacy and confidentiality.

3.12 Study Findings Dissemination

A comprehensive report will be written and submitted as part of the fulfillment of the course requirement for the award of master's degree. A research article will also be written and submitted for publication**.**

3.13 Study Limitations

The study utilized reported and documented secondary information from the study participants' medical records to obtain the intraoperative findings during the surgery. This dependency on secondary information could have introduced reporting bias.

The potential confounding variables such as comorbidities (i.e. diabetes mellitus, hypertension, HIV and other comorbidities) that influences treatment outcomes were not assessed. Most of this information was not captured in the participants medical records and since this was an observational study, an intervention to determine their findings could not be made.

The sample size included in the study is small to generalize the data on the public. The participants were recruited from one tertiary institution.

CHAPTER FOUR

4.0 FINDINGS

4.1 Social demographic characteristics of patients with mechanical intestinal obstruction due to neoplasms

The study included a total of 59 adult patients aged 21 to 83 years that were diagnosed with mechanical intestinal obstruction due to neoplasms at Moi Teaching and Referral Hospital in Eldoret, Kenya. Majority of the study participants were males comprising of 64.4% (n=38) compared to females 35.6% (n=21). The mean age of diagnosis at presentation was 51.4 ± 18.1 years as depicted in the table 18 below.

Table 18: Demographic characteristics of patients with mechanical intestinal obstruction due to neoplasms

	Small bowel	**Large bowel**	**Total**	**p-value**
Characteristics	**N=16**	**N=43**	**N=59**	
Gender				0.67
Male	11 (68.8%)	27 (62.8%)	38 (64.4%)	
Female	5 (31.3%)	16 (37.2%)	21 (35.6%)	
Age in years				
Mean (SD)	48.2 (19.4)	52.6 (17.8)	51.4 (18.1)	0.42
Range	21 – 76	23 – 83	21 – 83	

4.2 Presenting signs and symptoms of mechanical intestinal obstruction due to neoplasms

The most common complaints of patients presenting with operable mechanical intestinal obstruction due to neoplasms were constipation (96.6%) followed by abdominal pain (94.9%) and vomiting (79.7%). Other signs and symptoms included: abdominal distention (67.8%), weight loss (27.1%), rectal bleeding (15.3%) and less

frequently with easy fatigability and yellowness of eyes representing 3.4% each of the total complaints. Patients with small bowel obstruction presented more commonly with abdominal pain (93.8%) and vomiting (93.8%) while for large bowel obstruction, constipation (100%) and abdominal pain (95.3%) were the most common presenting symptoms as summarized in the table below.

Table 19: Presenting symptoms of mechanical intestinal obstruction due to neoplasms

	Small bowel N=16	Large bowel N=43	Total N=59
Presenting complaints			
Constipation	14 (87.5%)	43 (100.0%)	57 (96.6%)
Abdominal pain	15 (93.8%)	41 (95.3%)	56 (94.9%)
Vomiting	15 (93.8%)	32 (74.4%)	47 (79.7%)
zs Abdominal distention	8 (50.0%)	32 (74.4%)	40 (67.8%)
Easy fatigability	2 (12.5%)	0 (0.0%)	2 (3.4%)
Weight loss	4 (25.0%)	12 (27.9%)	16 (27.1%)
Yellowness of eyes	2 (12.5%)	0 (0.0%)	2 (3.4%)
Rectal bleeding	0 (0.0%)	9 (20.9%)	9 (15.3%)

4.3 Intraoperative findings of mechanical intestinal obstruction due to neoplasms

During the laparotomy, the anatomical location of the tumor is as outlined in the next section below.

4.3.1 Site of tumor obstruction

In 43 of the study participants (72.9%), the tumor affected the large bowel causing the mechanical intestinal obstruction compared to 16 (27.1%) which caused small bowel

obstruction. In large bowel obstruction, the most common sites affected by the tumor were the rectum (37.2%, n=16), sigmoid colon (27.9%, n=12) and the caecum (13.9%, n=6). Other sites less frequently obstructed were the ascending colon and descending colon at 7.0% each, transverse colon (4.6%, n=2) and the rectosigmoid colon (2.3%, n=1).

The proximal ileum was the most common site of small bowel obstruction by the tumor (43.7%, n=7) followed by the duodenum (37.5%, n=6). The Jejuno-ileum segment was the least affected site accounting for 18.8% (n=3). The table below summarizes the anatomical sites affected by the tumor causing mechanical intestinal obstruction.

Table 20: Anatomical location of neoplasms causing mechanical intestinal obstruction

Location of mechanical intestinal obstruction	Small bowel 16 (27.1%)	Proximal ileum 7 (43.7%)
		Duodenum 6 (37.5%)
		Jejuno-ileum 3 (18.8%)
	Large bowel 43 (72.9%)	Rectum 16 (37.2%)
		Sigmoid colon 12 (27.9%)
		Caecum 6 (13.9%)
		Ascending colon 3 (7.0%)
		Descending colon 3 (7.0%)
		Transverse colon 2 (4.6%)
		Rectosigmoid 1 (2.3%)

4.3.2 Other intraoperative findings for mechanical intestinal obstruction due to neoplasms

Other physical findings noted during the laparotomy for mechanical intestinal obstruction due to neoplasms included: Bowel ischemia (16.9%, n=10), adhesions 8.5% (n=5), ascites 6.8% (n=4), luminal narrowing (3.4%, n=2), and peritoneal seeding (1.7%, n=1).

Table 21: Other intraoperative findings of mechanical intestinal obstruction due to neoplasms

	Small bowel N=16	Large bowel N=43	Total N=59	p-value
Intra-op findings				
Bowel ischemia	2 (12.5%)	8 (18.6%)	10 (16.9%)	0.58
Adhesions	1 (6.3%)	4 (9.3%)	5 (8.5%)	0.71
Ascites	2 (12.5%)	2 (4.7%)	4 (6.8%)	0.29
Luminal narrowing	2 (12.5%)	0 (0.0%)	2 (3.4%)	0.018
Peritoneal seeding	0 (0.0%)	1 (2.3%)	1 (1.7%)	0.54

4.4 Pathological features for neoplasms causing mechanical intestinal obstruction

The most common histological diagnoses of tumors causing mechanical intestinal obstruction in the small bowel was adenocarcinoma accounting for 75% (n=12) of the total tumors affecting the small bowel. Others included Non-Hodgkins Lymphoma (18.8%, n=3) and benign chronic inflammatory process (6.3%, n=1). Adenocarcinoma was also the most common histological diagnosis of tumors causing mechanical large bowel obstruction accounting for 86.0% (n=37) of the total tumors affecting the large bowel. Other histological diagnoses for the large bowel tumors include: Neuroendocrine tumor (4.7%, n=2), Non Hodgkins Lymphoma (2.3%,n=1), Sarcoma

(2.3%, n=1), squamous cell carcinoma (2.3%, n=1) and benign chronic inflammatory process (2.3%, n=1).

Combined together, adenocarcinomas were the most common histological diagnoses for tumors that caused both small and large bowel mechanical intestinal obstruction accounting for 83.1% (n=49) of the total cases. It was followed by Non- Hodgkins Lymphoma (6.8%, n=4), neuroendocrine tumors (4.7%, n=2), benign chronic inflammatory condition (3.4%, n=2), squamous cell carcinoma (1.7%, n=1), and intra-abdominal sarcomas (1.7%, n=1).

Majority of the tumors affecting small and large bowel were grade 2 tumors accounting for 50% (n=8) and 62.8% (n=27) of the total cases for small bowel and large bowel tumors respectively. Cumulatively, grade 2 tumors was still the most common diagnosed histological grade for small and large bowel tumors accounting for 59.3% (n=35) of the total cases. Cumulatively for small and large bowel tumors, grades 1 and 3 were 13.6% (n=8) and 8.5% (n=5) respectively. The tumor grade was not specified in 15.3% (n=9) of the sample specimens for histological evaluation and in 3.4% (n=2), the grading was not applied because they were benign conditions as depicted in the table below.

Table 22: Pathologic features of neoplasms causing mechanical intestinal obstruction

	Small bowel	Large bowel	Total	p-value
Variable	**N=16**	**N=43**	**N=59**	
Histological type				0.23
Adenocarcinoma	12 (75.0%)	37 (86.0%)	49 (83.1%)	
Non-Hodgkin Lymphoma	3 (18.8%)	1 (2.3%)	4 (6.8%)	
Sarcoma	0 (0.0%)	1 (2.3%)	1 (1.7%)	
Squamous cell carcinoma	0 (0.0%)	1 (2.3%)	1 (1.7%)	
Chronic inflammatory process	1 (6.3%)	1 (2.3%)	2 (3.4%)	
Neuroendocrine tumor	0 (0.0%)	2 (4.7%)	2 (3.4%)	
Grade				0.77
1	3 (18.8%)	5 (11.6%)	8 (13.6%)	
2	8 (50.0%)	27 (62.8%)	35 (59.3%)	
3	2 (12.5%)	3 (7.0%)	5 (8.5%)	
N/A	1 (6.3%)	1 (2.3%)	2 (3.4%)	
Unspecified	2 (12.5%)	7 (16.3%)	9 (15.3%)	

4.5 Staging of malignant neoplasms causing mechanical intestinal obstruction

According to American Joint Committee on Cancer (AJCC) and Union for International Cancer Control (UICC) 8th edition classification system of the tumor size (T), nodal involvement (N) and extent of distant metastases (M) commonly referred as TNM staging was used to classify and assess extent of spread of the neoplasms that caused mechanical intestinal obstruction. For small bowel neoplasms, T4 neoplasms accounted for 43.8% (n=7) of the total cases while T3 and T2 accounted for 18.8% (n=3) and 12.5% (n=2) of the total cases respectively. In large bowel neoplasms, T4 was still the

most common tumor size found accounting for 69.8% (n=30) of the total neoplasms while T2 and T3 accounted for 4.7% (n=2) and 20.9% (n=9) respectively. Cumulatively T4 tumors was the commonest tumor size for both small and large bowel neoplasms accounting for 62.7% (n=37) of the total cases followed by T3 tumors (20.3%, n=12) and T2 tumors (6.8%, n=4). None of the study participants had T1/T0 tumors.

In terms of nodal involvement, 46 (77.9%) of the study participants had their nodes involved by the malignant neoplasms accounting for 56.3% (n=9) of the small bowel neoplasms and 86.0% (n=37) of large bowel neoplasms. In 3 (18.8%) of the study participants with small bowel neoplasms and 4 (9.3%) with large bowel neoplasms had no involvement of the lymph nodes by the neoplasms accounting for 11.9% (n=7) of the total cases.

When assessing the extent of distant metastases, 8 (50.0%) of the study participants with small bowel malignant neoplasms and 26 (60.5%) with large bowel neoplasms had metastatic disease accounting for 57.6% (n=34) of the total cases. Four (25.0%) of the study participants with small bowel malignant neoplasms and 12 (27.9%) with large bowel neoplasms had no distant metastases account for 27.1% (n=16) of the total cases. In 3 study participants their metastatic work up could not be assessed therefore marked as Mx.

In 6 study participants, the AJCC/UICC TNM staging system could not be applied as they had chronic inflammatory conditions and lymphomas. The TNM staging system for small and large bowel malignant neoplasms is as summarized in the table below.

Table 23: Clinical staging of neoplasms causing mechanical intestinal obstruction

	Small bowel	Large bowel	Total	p-value
Variable	**N=16**	**N=43**	**N=59**	
Tumor size				0.069
T2	2 (12.5%)	2 (4.7%)	4 (6.8%)	
T3	3 (18.8%)	9 (20.9%)	12 (20.3%)	
T4	7 (43.8%)	30 (69.8%)	37 (62.7%)	
N/A	4 (25.0%)	2 (4.7%)	6 (10.2%)	
Nodal involvement				0.065
N0	3 (18.8%)	4 (9.3%)	7 (11.9%)	
N1	2 (12.5%)	12 (27.9%)	14 (23.7%)	
N2	7 (43.8%)	25 (58.1%)	32 (54.2%)	
N/A	4 (25.0%)	2 (4.7%)	6 (10.2%)	
Metastasis				0.11
M0	4 (25.0%)	12 (27.9%)	16 (27.1%)	
M1	8 (50.0%)	26 (60.5%)	34 (57.6%)	
Mx	0 (0.0%)	3 (7.0%)	3 (5.1%)	
N/A	4 (25.0%)	2 (4.7%)	6 (10.2%)	

4.6 Surgical interventions offered for patients with mechanical intestinal obstruction due to neoplasms

During the laparotomy for mechanical intestinal obstruction due to neoplasms, the most common surgical intervention offered small bowel obstruction was bypass (62.5%, n=10) followed by resection and anastomosis (50.0%, n=8). The least common surgical intervention offered was creation of a diversion stoma (18.8%, n=3). In large bowel obstruction, creation of a diversion stoma was the commonest procedure performed (72.1%, n=31), followed by resection and anastomoses (41.9%, n=18). Bypass procedure was the least performed procedure (9.3%, n=4).

Cumulatively, creation of a diversion stoma was the commonest procedure performed for small and large bowel mechanical intestinal obstruction caused by neoplasms accounting for 57.6% (n=34) of the total procedures. Resection and anastomoses and bypass procedures accounted for 44.1% (n=26) and 23.7% (n=14) respectively.

The surgical interventions offered are summarized in the tale below.

Table 24: Surgical interventions offered for mechanical intestinal obstruction due to neoplasms

	Small bowel N=16	**Large bowel N=43**	**Total N=59**	**p-value**
Surgical intervention offered				
Diversion stoma	3 (18.8%)	31 (72.1%)	34 (57.6%)	<0.001
Resection and anastomosis	8 (50.0%)	18 (41.9%)	26 (44.1%)	0.58
Bypass	10 (62.5%)	4 (9.3%)	14 (23.7%)	<0.001

4.7 Factors affecting early treatment outcomes

After surgery to relieve the mechanical intestinal obstruction caused by neoplasms, 11 (68.8%) of the study participants who had presented with small bowel neoplasms and 29 (67.4) with large bowel neoplasms developed complications during their inpatient stay accounting for 67.8% (n=40) of the total complications. In patients who had small bowel obstruction, the commonest complications included electrolyte imbalance (90.9%, n=10), persistent ileus more than 72 hours (81.8%, n=9) and infection on surgery site (81.8%, n=9). Other complications encountered were fevers (27.3%, n=3), anemia and stoma retraction accounting for (9.1%, n=1) each.

For patients who had large bowel obstruction due to neoplasms, infection involving the surgery site (69.0%, n=20) was the commonest complication encountered followed by electrolyte imbalance (48.3%, n=14) and persistent ileus for more than 72 hours (37.9%, n=11). Other complications included development of fevers (20.7%, n=3), anemia (27.6%, n=8), stoma prolapse (17.2%, n=5), early bowel obstruction (6.9%, n=2), gangrenous stoma and stoma retraction accounting for 3.4% (n=1) each.

Combined together, the most common complications encountered after surgery in study participants were the infection involving the surgery site (72.5%, n=29), electrolyte imbalance (60%, n=24) and persistent ileus >72 hours (50%, n=20). Others less common post-surgery complications included: Fevers (22.5%, n=9), anemia (22.5%, n=9), stoma prolapse (12.2%, n=5), stoma retraction (4.9%, n=2), early bowel obstruction (5.0%, n=2) and gangrenous stoma (2.5%, n=1).

The length of hospital stay ranged from 4 to 40 days with a median of 10 days for all study participants. Those with small bowel obstruction stayed in the hospital for about 8 days and 12 days for those with large bowel obstruction. Three study participants (15%) who had presented with small bowel obstruction and 4 (8.9%) with large bowel obstruction had died by the end of 30 days after surgery contributing to 10.8% (n=7) 30-day postoperative mortality rate for neoplasms causing mechanical bowel obstruction. Three of the patients died while they were at the hospital due to septicemia while 4 died while recuperating at home due to unknown reasons. These early treatment outcomes are summarized in the table below.

Table 25: Early treatment outcomes of mechanical intestinal obstruction due to neoplasms

Variables	Small bowel N=16	Large bowel N=43	Total N=59
Complications			
No	5 (31.3%)	14 (32.6%)	19 (32.2%)
Yes	11 (68.8%)	29 (67.4%)	40 (67.8%)
Specific complication			
Fevers	3 (27.3%)	6 (20.7%)	9 (22.5%)
Electrolyte imbalance	10 (90.9%)	14 (48.3%)	24 (60.0%)
Persistent ileus	9 (81.8%)	11 (37.9%)	20 (50.0%)
Surgical site infection	9 (81.8%)	20 (69.0%)	29 (72.5%)
Anemia	1 (9.1%)	8 (27.6%)	9 (22.5%)
Early bowel obstruction	0 (0.0%)	2 (6.9%)	2 (5.0%)
Gangrenous Stoma	0 (0.0%)	1 (3.4%)	1 (2.5%)
Stoma retraction	1 (9.1%)	1 (3.4%)	2 (4.9%)
Stoma prolapse	0 (0.0%)	5 (17.2%)	5 (12.2%)
Length of hospital stay in days			
Median (IQR)	8.0 (5.5-10.0)	12.0 (6.0-15.0)	10.0 (6.0-14.0)
Range	4 – 40	4 – 35	4 – 40
30-day mortality rates	3 (15%)	4(8.9 %)	7 (10.8%)

4.8 Correlation between demographic and clinical characteristics and complications

The study participants who developed post-surgery complications were associated with longer hospital stays of average 12 versus 5 days as compared to those who did not develop complications which was statistically significant ($p < 0.001$). Study participants with grade 1 malignant neoplasms had higher chances of developing complications compared to other grades and this was considered statistically significant ($P=0.003$). Having mechanical large bowel obstruction was associated with higher chances of developing post-surgery complications when compared to small bowel but this was not statistically significant ($p=0.924$). The age of the study participants ($p=0.241$), and gender ($p=0.472$) were not associated with the development of post-surgery complications as summarized in the table below.

Table 26: Correlation of clinical features and early treatment complication rates

Variables	Complications		Total	p-value
	No	**Yes**		
	N=19	**N=40**	**N=59**	
Age in years	55.4 (20.5)	49.5 (16.9)	51.4 (18.1)	0.241[3]
Gender				0.472[1]
Male	11 (28.9%)	27 (71.1%)	38 (100.0%)	
Female	8 (38.1%)	13 (61.9%)	21 (100.0%)	
Site of obstruction				0.924[1]
Small bowel	5 (31.3%)	11 (68.8%)	16 (100.0%)	
Large bowel	14 (32.6%)	29 (67.4%)	43 (100.0%)	
Length of hospital stay	5.0 (5.0-6.0)	12.0 (10.0-15.5)	10.0 (6.0-14.0)	<0.001[4]
Grade				
1	1 (12.5%)	4 (87.5%)	5	0.003[2]
2	10 (28.6%)	25 (71.4%)	35	
3	5 (100.0%)	0	5	

[1] Chi Square test
[2] Fisher's exact test
[3] *t*test
[4] Mann Whitney U test

CHAPTER FIVE

5.1 DISCUSSION

The neoplasms causing mechanical intestinal obstruction necessitating surgical intervention are among the commonest causes of hospital visit to the emergency department. Patients with different demographic characteristics are usually encountered while seeking care. In this study males were more commonly affected by neoplasms causing mechanical intestinal obstruction compared to females. Worldwide, males are more commonly affected by neoplasms causing mechanical intestinal obstruction. Similar findings were seen in studies done by (Saidi et al 2011) in Kenya, Ohene Yeboah et al 2006 in Ghana and Kube et al 2010 in Germany where males were shown to be more affected by neoplasms causing mechanical intestinal obstruction. Most patients affected were in their 5^{th} decade of life. As seen, neoplasms is more common in patients with advanced age of 50-60 years of age. A study done by Saidi et al 2011 showed that the average age of patients affected by colorectal cancer was 52 years. In Ghana and Uganda, patients who presented with large bowel obstruction due to malignancies, their age ranged from 50-53 years of age (Ohene-Yeboah et al., 2006; Okeny et al., 2011). A study done by (Etissa, Assefa, & Ayele, 2021) in Ethiopia contrasted our findings where a younger male study population of 40-49 years were more commonly affected by malignancies causing bowel obstruction. With the increasing cases of malignancies being diagnosed every year, a shift in the age bracket, where younger patient generation are seen to be more affected by malignancies. However, this remains an issue to be further investigated as to the reason for younger age diagnosis.

In this study there was no significant difference between presenting complaints for mechanical intestinal obstruction due to either small bowel or large bowel neoplasms.

They mostly presented with abdominal pain, constipation and vomiting. Small bowel and large bowel neoplasms causing complete intestinal obstruction mostly present the same in terms of symptomatology. A study done by Markogiannakis et al, 2007 showed that patients who had small and large bowel obstructions due to malignancies presented the same with abdominal pain, vomiting, abdominal tenderness and distention. Similar findings were obtained by Zahir et al.,2019 in small bowel malignancies causing bowel obstruction which presented with abdominal pain, vomiting, abdominal tenderness and distention. Malignancies located in the rectum may present more with rectal bleeding. Small bowel malignancies have also been shown to present with rectal bleeding (Vallicelli et al, 2011). The symptoms of mechanical intestinal obstruction have been shown to lack sensitivity in terms of pointing the neoplasm location and therefore are largely nonspecific (Markogiannakis et al 2007). This contrasted our findings which showed that bleeding is a symptom associated with large bowel neoplasms.

The large bowel was more commonly affected by neoplasms causing mechanical bowel obstruction necessitating surgery in our set up compared to small bowel obstruction**.** Similar findings were found in Tenwek Kenya and in Mogadishu Somalia where the large bowel obstruction with neoplasm was twice encountered as small bowel obstruction (Eren, Ankaralı, & Alimoglu, 2017; Ooko et al., 2015). In western world, large bowel obstruction by neoplasm is still more common than small bowel accounting for 47-60% of the cases (Capona et al., 2021; Cappell & Batke, 2008; Farkas et al., 2019; Markogiannakis et al., 2007). These findings reinforce what is already known that the large bowel is more commonly affected by neoplasms as compared to small bowel due to delayed transit time of luminal contents in large bowel allowing for long exposure to carcinogens, and presence of micro bacteria in large colon that produce carcinogens that promote cancer development.

Left colon distal to splenic flexure was the most common affected compared to the right. Left colon is more affected by neoplasms than the right as shown by (Capona et al., 2021; Farkas et al., 2019). The left colon is narrower compared to the right hence can easily obstruct given the reduced bowel diameter compared to the right. The sigmoid and rectum are the most commonly affected segments of the colon (Markogiannakis et al., 2007; Richard Wismayer, 2020; R. Wismayer, Kiwanuka, Wabinga, & Odida, 2023). In small bowel obstruction, the proximal ileum was the most affected part by neoplasms. In a study done by (Aparicio et al. 2013) showed similar findings where the proximal ileum was more affected than the duodenum due to the blood supply. The proximal ileum is more perfused with blood supply when compared to the duodenum.

In this study most of the neoplasms biopsied were malignant adenocarcinomas of the large and small bowel followed by Non-Hodgkin's Lymphoma. This is comparable with studies done by (Low, Chen, & Barone, 2003; Vallicelli et al., 2011) which demonstrated that most neoplasms that occurred in small and large bowel were the adenocarcinomas followed by lymphomas especially the Non-Hodgkin's Lymphoma. In West Africa similar findings were obtained by (Irabor & Adedeji, 2009) in which adenocarcinomas were the most common cancer diagnosis of the large bowel. For neoplasms causing small bowel obstruction, adenocarcinomas located in proximal bowel were the most common closely followed by Lymphomas due to associated gut lymphoid tissue. Most of the lymphomas were Non-Hodgkins's Lymphoma of B cell origin. (Markogiannakis et al., 2007; Vallicelli et al., 2011). Contrast to our study findings, carcinoid tumors were more common cause of small bowel malignancies in the US followed closely by adenocarcinomas (Billimoria et al.2009). Tumor biology and geographical location differences could have played a role in the difference.

Majority of the neoplasms diagnosed were well to moderately differentiated grades. In a study done in Kenya by (H Saidi et al., 2011) demonstrated that well to moderately differentiated adenocarcinomas of the colon were the commonest malignant neoplasms of the colon. Similarly, in Uganda and Tanzania, moderately differentiated adenocarcinomas were the most common neoplasms of the colon accounting for more than 88% (Chalya et al., 2013; Dijxhoorn et al., 2014) .

Other intraoperative findings obtained when carrying out surgical interventions to relieve the bowel obstruction included adhesions, ascites, ischemic bowel, luminal narrowing and peritoneal seeding. These features point out towards advanced disease status at presentation. Similar findings were obtained by Adhikari et al. 2010 and Kube et al 2010. where features of advanced disease at the time of surgery included intraabdominal mass, bowel gangrene, ischemia and necrosis, and peritoneal carcinomatosis which indicated poor prognosis (Adhikari, Hossein, Das, Mitra, & Ray, 2010; Kube et al., 2010; Yu et al., 2020).

In this study most of the malignant bowel neoplasms diagnosed were at advanced stage. This is evidenced by both T3 and T4 tumors being the commonest tumor size at presentation with nodal involvement and in the metastatic setting. Late-stage bowel malignancy presentation with nodal involvement and in metastatic setting is a common presentation for intestinal tumors. In Ethiopia and Kenya most large bowel malignancies were diagnosed at advanced stages with nodal involvement and in metastatic setting with poor treatment outcomes (Etissa et al., 2021; HS Saidi et al., 2008). Similarly small bowel malignancies were diagnosed late and were at advanced stages at diagnosis (Vallicelli et al., 2011). Delay in seeking care until when the patient is symptomatic, invasiveness of colon cancer screening and lack of screening test for small bowel malignancies have been attributed to the general late presentation for large

and small bowel malignancies leading to poor treatment outcomes especially in Sub-Saharan Africa. However, this is contrast in the western population especially in the US where most intestinal tumors are diagnosed early and have good treatment outcomes. Tumor biology and access to early diagnosis and treatment services may have been attributed as the influencing factors in terms of treatment outcomes (Polite, Dignam, & Olopade, 2006).

The most common surgical intervention offered intraoperatively for small bowel obstruction due to neoplasms compared to large bowel obstruction were the resection and anastomosis and bypass surgery. For large bowel obstruction creation of a diversion stoma was performed more commonly than in small bowel obstruction. In India and United Kingdom primary resection and anastomosis and bypass surgeries were more common in small bowel obstruction by neoplasms (Adhikari et al., 2010; Ferguson et al., 2015). For large bowel obstruction by neoplasms, fecal diversion was the most common performed surgical intervention in patients with advanced large bowel malignancies (Capona et al. 2021). The difference in the interventions offered for small and large bowel obstructions by neoplasms was the ease of performance of the procedure given the disease is already advanced at the time of presentation due to the ability to cause bowel obstruction by intraluminal occlusion or extraluminal compression. In both small and large bowel obstruction due to neoplasms, the bowel resection and anastomosis, bypass surgery and fecal diversion through a stoma were the commonest procedures performed in the emergency setting (Yu et al., 2020; Capona et al., 2021; Franke et al., 2017).

Majority of the study participants experienced complications during their hospital inpatient period. The most common complications in small bowel obstruction patients were the electrolyte imbalance, persistent ileus and surgical site infection. In large

bowel obstruction patients, surgical site infection, electrolyte imbalance and persistent ileus were the commonest complications. Notably the three most common post operative complications for both small and large bowel obstruction due to neoplasms were the surgical site infection, electrolyte imbalance and persistent ileus. A study done by (Simachew et al., 2021) in Ethiopia, showed that surgical site infection and wound dehiscence were the leading complications in patients who underwent surgery as a result of bowel obstruction due to malignancies. Similarly, in China, the patients who underwent surgery due to malignant bowel obstruction developed postoperative anastomotic leak and surgical site infection as the most common complications (Yu et al., 2020). The patients with advanced malignancies tend to have low immunity due to the disease process or disease directed treatment therapy that predisposes them to develop complications and have longer duration of hospital stays. The complications encountered mostly are attributed to the procedures performed to relieve the obstruction such as fecal diversion. The cause of complications is multifactorial.

In this study, patients with large bowel obstruction due to neoplasms had a longer duration of hospital stay when compared to small bowel obstruction. The duration varied from 8-12 days for small and large bowel obstruction patients with an average of 10 days. Similar findings were found in Ethiopia, whereby patients with bowel obstruction due to malignancies had a prolonged hospital stay of more than 14 days (Eren et al., 2017). In Brazil, the length of hospital stay varied from 10-18 days for patients with malignant bowel obstruction (Caldas et al., 2023). A study done in China showed that postoperatively, malignant bowel obstruction was associated with longer hospital stay with a median of 17 days (Yu et al., 2020). Generally, patients with neoplasms tend to have longer length of hospital stay compared to the other patients.

This is due to higher complication rates, and prolonged healing process that is associated with low immunity.

The 30-day postoperative mortality rate for small and large bowel obstruction due to neoplasms was high in this study. The adjusted 30-day mortality post operatively for malignant small bowel obstruction in the US was 14.5% (Wancata et al., 2017). In Germany, the postoperative 30-day mortality for mechanical malignant bowel obstruction ranged from 5-30%. The difference for the range was explained by inclusion of young and geriatric patients where the mortality was low in young patients and high in elderly patients (Paul et al., 2022). As shown, patients with advanced neoplasms causing mechanical bowel obstruction tend to have higher mortality rates when compared to normal population. This was attributed to higher complication rates, poor nutrition and physical performance status and weakened immunity. (Yu et al., 2020; Adhikari et al., 2010). Septicemia was the major contributory factor for the inpatient mortality. Other commonest causes of mortality in this category of patients globally include renal failure and respiratory failure (Krouse et al 2017).

The prognostication factors included large bowel obstruction, tumor grade, complication rate and length of hospital stay. The patients with large bowel obstruction due to neoplasm which were well to moderately differentiated, were more likely to develop complications which was associated with longer duration of hospitalization. Large bowel surgeries were associated with higher complication rate than small bowel surgeries. In studies done in Kenya, Uganda, and Ethiopia, share similar sentiments in which large bowel neoplasms causing intestinal obstruction were well to moderately differentiated neoplasms and were associated with higher complication rates causing longer duration of hospital stay of 10-15 days (Dijxhoorn et al., 2014; Etissa et al., 2021; Okeny et al., 2011; H Saidi et al., 2011).

CHAPTER SIX

6.1 CONCLUSIONS

1. Males were more commonly affected by neoplasms causing mechanical intestinal obstruction at Moi Teaching and Referral Hospital.
2. Majority of the malignant neoplasms causing acute mechanical intestinal obstruction were at advanced stage during presentation at the hospital.
3. Surgical fecal diversion through creation of a stoma was the most common interventions offered for the mechanical intestinal obstruction due to neoplasms at Moi Teaching and Referral Hospital.
4. Surgical site infection was the commonest post-surgery complication encountered in acute mechanical intestinal obstruction due to neoplasms at Moi Teaching and Referral Hospital.

6.2 RECOMMENDATIONS

1. To Moi Teaching and Referral Hospital (MTRH) administration: There is need to sensitize the male patients on neoplasms causing mechanical intestinal obstruction to facilitate high index of suspicion and seek treatment services early.
2. To the local county government of Uasin Gishu: There is need for community education and awareness on neoplasms causing mechanical intestinal obstruction. This is to facilitate cancer screening, early detection and early treatment which are associated with better treatment outcomes.
3. To the General Surgery Residents and Consultants at MTRH: Oncologic surgical knowledge and skills are of critical importance in order to offer optimum care to patients presenting with neoplasms causing mechanical

intestinal obstruction. Therefore, there is need for further training and reinforcement of oncological surgical resections in the emergency setting.

4. To the General Surgery inpatient team of doctors and nurses: Prompt recognition and management of mechanical intestinal obstruction to facilitate adequate resuscitation and prompt treatment to avert complications that may arise during the post operative period.

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APPENDICES

APPENDIX I: INFORMED CONSENT FORM

MOI UNIVERSITY COLLEGE OF HEALTH SCIENCES / MOI TEACHING AND REFERRAL HOSPITAL
INSTITUTIONAL RESEARCH AND ETHICS COMMITTEE (IREC) INFORMED CONSENT FORM (ICF)

Study Title: Clinicopathological features and early treatment outcomes of neoplasms causing intestinal obstruction at Moi Teaching and Referral Hospital in Eldoret, Kenya.

Name of Principal Investigator(s): Dr. Nicholas Kisilu, M.B.ChB.
Co Investigators: Dr. Simiyu Tabu M.B.ChB, M.Med; Dr. JoAnna L. Hunters-Squires, MD; Dr. Dan Ndiwa, M.B.ChB, M.Med.

Name of Organization: Moi University School of Medicine.

Name of Sponsor: N/A

Informed Consent Form for: Participants 18 years and above with neoplasms causing mechanical intestinal obstruction at Moi Teaching and Referral Hospital.

This Informed Consent Form has two parts:

- Information Sheet (to share information about the study with you)
- Certificate of Consent (for signatures if you choose to participate)

You will be given a copy of the signed Informed Consent Form

Part I: Information Sheet

Introduction:

You are being asked to take part in a research study. This information is provided to tell you about the study. Please read this form carefully. You will be given a chance to ask questions. If you decide to be in the study, you will be given a copy of this consent form for your records.

Taking part in this research study is voluntary. You may choose not to take part in the study. You could still receive other treatments. Saying no will not affect your rights to health care or services. You are also free to withdraw from this study at any time. If after data collection

you choose to quit, you can request that the information provided by you be destroyed under supervision- and thus not used in the research study. You will be notified if new information becomes available about the risks or benefits of this research. Then you can decide if you want to stay in the study.

Purpose of the study:

The purpose of the study is to find out the features of tumors blocking your digestive tract, what was done to you in theatre and to find out if there are complications that you may go through after the surgery.

Type of Research Project/Intervention:

This will be observational research looking at signs and symptoms at hospital admission, characteristics of tumor causing intestinal obstruction in theatre, intervention offered to you and if there are nay complications that you may develop after the surgery. All the information will be collected using a questionnaire.

Why have I been identified to Participate in this study?

This is because you have a tumor that is blocking your intestines.

How long will the study last?

This study will last for a period of one year. However, your participation is during the current hospital admission and for a follow up duration of 6 weeks after hospital's discharge.

What will happen to me during the study?

A. Provide a brief introduction to the format of the research study.
We are asking you to help us learn more about tumors blocking the intestines. If you accept, you will be asked to describe the symptoms you experienced before presenting to a hospital for admission. After you have been done surgery you will asked to describe any complications that you may experience.

Explain the type of questions that the participants are likely to be asked in the focus group, the interviews, the survey or other relevant approach. If the research involves questions or discussion which may be sensitive or potentially cause embarrassment, inform the participant of this.

You will be asked information regarding your age, status of marriage and education level, the symptoms you experienced before hospital admission and any complaints that you may have after the surgery.

What side effects or risks I can expect from being in the study?

We are expecting you to experience no side effects from participating in this study since it is non interventional**.**

Are there benefits to taking part in the study?

There are no direct benefits from this study. However the information gathered will be useful to doctors and the society by providing more information on tumors causing bocking of the intestines.

Reimbursements:

There will no monetary compensation expected from participating in this study.

Who do I call if I have questions about the study?
Questions about the study: Dr. Nicholas Kisilu Mobile number 0729709118

Questions about your rights as a research subject:
You may contact Institutional Review Ethics Committee (IREC) 053 33471 Ext.3008. IREC is a group of people that reviews studies for safety and to protect the rights of study subjects.

Will the information I provide be kept private?

All reasonable efforts will be made to keep your protected information (private and confidential. Protected Information is information that is, or has been, collected or maintained and can be linked back to you. Using or sharing ("disclosure") of such information must follow National privacy guidelines. By signing the consent document for this study, you are giving permission ("authorization") for the uses and disclosures of your personal information. A decision to take part in this research means that you agree to let the research team use and share your Protected Information as described below.

As part of the study, Dr. Nicholas Kisilu and his study team may share the results of your CT scans, surgery and pathology findings. These may be study or non-study related. They may also share portions of your medical record, with the groups named below:

- The National Bioethics. Committee,
- The Institutional Review and Ethics Committee,

National privacy regulations may not apply to these groups; however, they have their own policies and guidelines to assure that all reasonable efforts will be made to keep your personal information private and confidential.

[**OPTIONAL**: The PI may give your personal health information, not containing your name, to others or use it for research purposes other than those listed in this form. In handling your personal information PI and associated staff will keep your information in strict confidence, and shall comply with any and all applicable laws regarding the confidentiality of such information.]

The study results will be retained in your research record for at least six years after the study is completed. At that time, the research information not already in your medical record will be disposed of safely using the outlined procedures. Any research information entered into your medical record will be kept indefinitely.

Unless otherwise indicated, this permission to use or share your Personal Information does not have an expiration date. If you decide to withdraw your permission, we ask that you contact **Dr. Nicholas Kisilu** in writing and let him know that you are withdrawing your permission. The mailing address is **nkkisilu33@gmail.com**. At that time, we will stop further collection of any information about you. However, the health information collected before this withdrawal may continue to be used for the purposes of reporting and research quality.

[**OPTIONAL**: You have the right to see and copy your personal information related to the research study for as long as the study doctor or research institution holds this information. However, to ensure the scientific quality of the research study, you will not be able to review some of your research information until after the research study has been completed.]

Your treatment, payment or enrollment in any health plans or eligibility for benefits will not be affected if you decide not to take part. You will receive a copy of this form after it is signed.

Part II: Consent of Subject:

I have read or have had read to me the description of the research study. The investigator or his/her representative has explained the study to me and has answered all of the questions I have at this time. I have been told of the potential risks, discomforts and side effects as well as the possible benefits (if any) of the study. I freely volunteer to take part in this study.

_____	_____	_____
Name of Participant (Witness to print if the subject is unable to write)	Signature of subject/thumbprint	Date & Time

_____ _____

Name of Representative/Witness		Relationship to Subject
_____	_____	_____
Name of person Obtaining Consent	Signature of person Obtaining Consent	Date
_____	_____	_____
Printed name of Investigator	Signature of Investigator	Date

APPENDIX II: DATA COLLECTION TOOL

PART A: Sociodemographic Characteristics

Participant ID_____

1. Gender
   a. Male ☐ b. Female ☐
2. Date of Birth ……. (*dd:mm:yyyy*)
3. Age…… (*in years*)
4. Marital Status:
   a. Married ☐
   b. Single ☐
   c. Divorced ☐
5. Residence**:**
   a. Urban ☐ b. Rural ☐
6. County of residence …….

PART B: Clinicopathologic features of tumors causing intestinal obstruction

7. Have you ever smoked cigarettes?
   a. Yes ☐ b. No ☐
8. If yes, for how long? _____(in years)
9. How many sticks per day on average? _____
10. Have you ever consumed alcohol?
    a. Yes ☐ b. No ☐
11. If yes, for how long?_____ (in years)
12. Have you ever been screened for an abdominal cancer?

a. Yes ☐ b. No ☐

13. If yes specify_____
14. Presenting symptoms and duration

a. Vomiting ☐
b. Abdominal Pain ☐
c. Rectal bleeding ☐
d. Weight Loss ☐
e. Constipation ☐

15. Site of intestinal obstruction
    a. Antrum ☐
    b. Duodenum ☐
    c. Jejunum ☐
    d. Ileum ☐
    e. Colon
        i. Ascending Colon ☐
        ii. Transverse Colon ☐
        iii. Descending Colon ☐
        iv. Sigmoid Colon ☐
    f. Rectum ☐

16. Tumour Size in cm: ……..

17. Nodal Involvement
    a) N_x ☐
    b) N_0 ☐
    c) N_1 ☐
    d) N_2 ☐
    e) N_3 ☐

18. Metastasis
    a) M_x ☐
    b) M_0 ☐
    c) M_1 ☐

Histopathology Report

19. Biopsy site
    a. Stomach antrum ☐
    b. Duodenum ☐
    c. Jejunum ☐
    d. Ileum ☐
    e. Caecum ☐
    f. Appendix ☐
    g. Ascending colon ☐
    h. Transverse colon ☐
    i. Descending colon ☐
    j. Rectum ☐
    k. Other. Specify.....

20. Histological characteristics
    a. Benign ☐
    b. Malignant ☐

21. Histological type:
Specify.....

22. Grade:
    a. Undifferentiated ☐
    b. Well Differentiated ☐
    c. Moderately Differentiated ☐
    d. Poorly Differentiated ☐

Treatment and early outcomes

23. Surgical interventions offered
    i. Diversion ☐
    ii. Stoma fashioning ☐
    iii. Resection and anastomosis ☐
    iv. Bypass ☐
    v. Other (specify) _____

24. Intraoperative findings
    i. Mass ☐
    ii. Friable tissue ☐
    iii. Perforation ☐
    iv. Bleeding ☐
    v. Other (specify)_____

~~25.~~ Early surgical complications
    a. Anastomotic leak ☐
    b. Fevers ☐
    c. Persistent ileus (>72 hours) ☐
    d. Electrolyte Derangement ☐
    e. Gut necrosis ☐
    f. Enterocutaneous Fistula ☐
    g. Intra-abdominal bleeding ☐
    h. Stoma Retraction ☐
    i. Stoma Prolapse ☐
    j. Early Bowel Obstruction ☐
    k. Septicemia ☐
    l. Surgical site infection ☐
    m. Other (specify)_____ ☐

26. Duration of post-surgical hospitalization (specify number in days) ……..

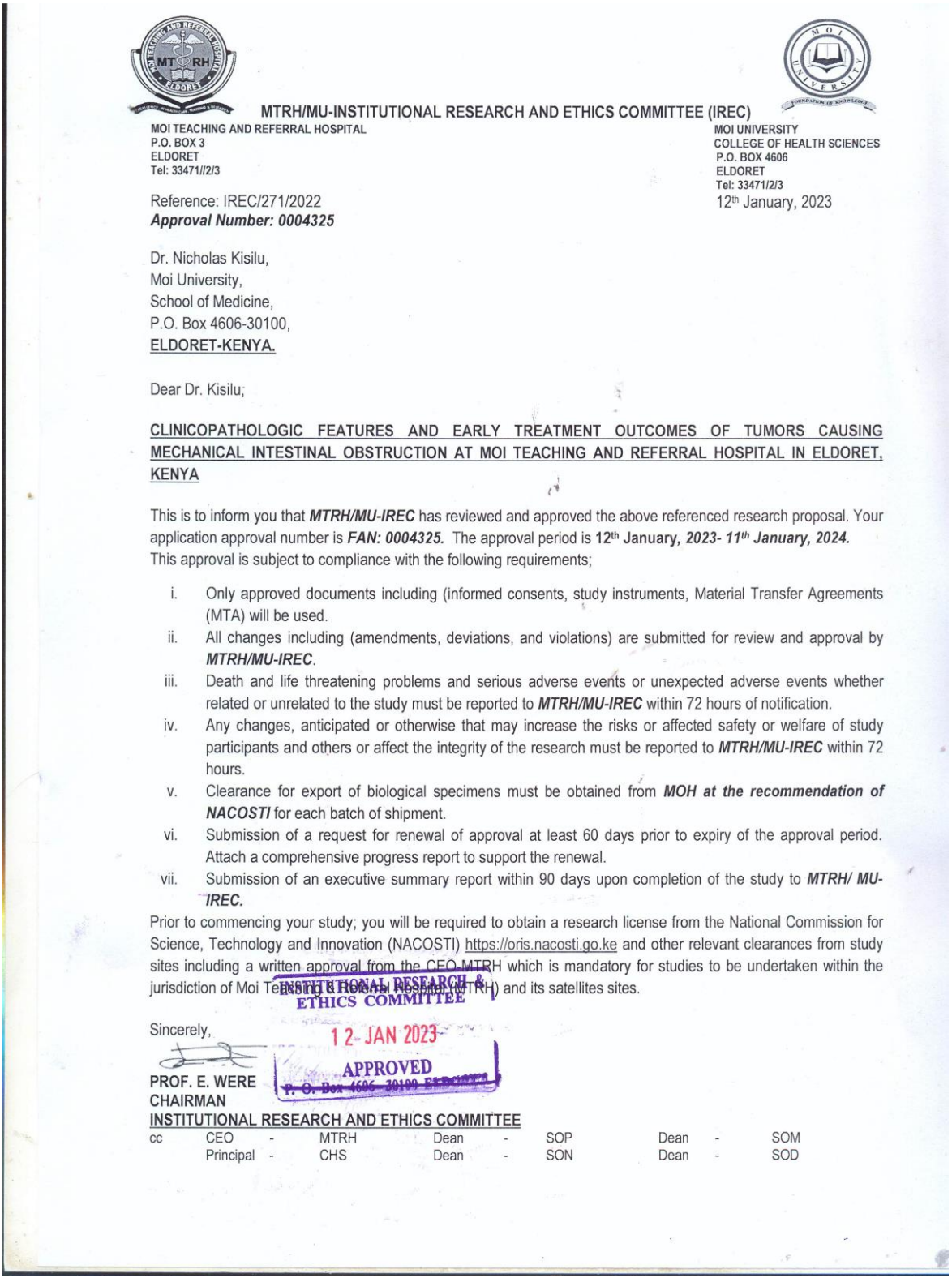
27. After 4 weeks postoperatively, was the participant able to assume his normal daily functions
    a. Yes ☐ b. No ☐

28. If No specify why……

29. Has the participant received any care related to the tumor after hospital discharge during the 4th week follow-up postoperatively?
    a. Yes ☐ b. No ☐

30. If yes specify:…….

APPENDIX III: INSTITUTIONAL RESEARCH AND ETHICS COMMITTEE LETTER



MTRH/MU-INSTITUTIONAL RESEARCH AND ETHICS COMMITTEE (IREC)

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

MOI UNIVERSITY
COLLEGE OF HEALTH SCIENCES
P.O. BOX 4606
ELDORET
Tel: 33471/2/3

Reference: IREC/271/2022
Approval Number: 0004325

12th January, 2023

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

Dear Dr. Kisilu;

CLINICOPATHOLOGIC FEATURES AND EARLY TREATMENT OUTCOMES OF TUMORS CAUSING MECHANICAL INTESTINAL OBSTRUCTION AT MOI TEACHING AND REFERRAL HOSPITAL IN ELDORET, KENYA

This is to inform you that ***MTRH/MU-IREC*** has reviewed and approved the above referenced research proposal. Your application approval number is ***FAN: 0004325.*** The approval period is **12th January, *2023- 11th January, 2024.***
This approval is subject to compliance with the following requirements;

i. Only approved documents including (informed consents, study instruments, Material Transfer Agreements (MTA) will be used.
ii. All changes including (amendments, deviations, and violations) are submitted for review and approval by ***MTRH/MU-IREC***.
iii. Death and life threatening problems and serious adverse events or unexpected adverse events whether related or unrelated to the study must be reported to ***MTRH/MU-IREC*** within 72 hours of notification.
iv. Any changes, anticipated or otherwise that may increase the risks or affected safety or welfare of study participants and others or affect the integrity of the research must be reported to ***MTRH/MU-IREC*** within 72 hours.
v. Clearance for export of biological specimens must be obtained from ***MOH at the recommendation of NACOSTI*** for each batch of shipment.
vi. Submission of a request for renewal of approval at least 60 days prior to expiry of the approval period. Attach a comprehensive progress report to support the renewal.
vii. Submission of an executive summary report within 90 days upon completion of the study to ***MTRH/ MU-IREC.***

Prior to commencing your study; you will be required to obtain a research license from the National Commission for Science, Technology and Innovation (NACOSTI) https://oris.nacosti.go.ke and other relevant clearances from study sites including a written approval from the CEO-MTRH which is mandatory for studies to be undertaken within the jurisdiction of Moi Teaching & Referral Hospital (MTRH) and its satellites sites.

INSTITUTIONAL RESEARCH & ETHICS COMMITTEE

Sincerely,

12 JAN 2023

APPROVED
P. O. Box 4606 - 30100 ELDORET

PROF. E. WERE
CHAIRMAN
INSTITUTIONAL RESEARCH AND ETHICS COMMITTEE

cc CEO - MTRH Dean - SOP Dean - SOM
Principal - CHS Dean - SON Dean - SOD

APPENDIX IV: MOI TEACHING AND REFERRAL HOSPITAL APPROVAL LETTER

An ISO 9001:2015 Certified Hospital

MOI TEACHING AND REFERRAL HOSPITAL

Telephone: (+254)-0532033471/2/3/4
Fax: 0532061749
Email: ceo@mtrh.go.ke/ceosoffice@mtrh.go.ke

NANDI ROAD
P.O. BOX 3-30100
ELDORET,KENYA

Ref: ELD/MTRH/R&P/10/2/V.2/2010

20th January, 2023

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

CLINICOPATHOLOGIC FEATURES AND EARLY TREATMENT OUTCOMES OF TUMORS CAUSING MECHANICAL INTESTINAL OBSTRUCTION AT MOI TEACHING AND REFERRAL HOSPITAL IN ELDORET, KENYA

You have been authorised to conduct research within the jurisdiction of Moi Teaching and Referral Hospital (MTRH) and its satellites sites. You are required to strictly adhere to the regulations stated below in order to safeguard the safety and well-being of staff, patients and study participants seen at MTRH.

1. The study shall be under Moi Teaching and Referral Hospital regulation.
2. A copy of MTRH/MU-IREC approval shall be a prerequisite to conducting the study.
3. Studies intending to export human bio-specimens must provide a permit from MOH at the recommendation of NACOSTI for each shipment.
4. No data collection will be allowed without an approved consent form(s) to participants unless waiver of written consent has been granted by MTRH/MU-IREC.
5. Take note that **data** collected must be treated with due confidentiality and anonymity.

The continued permission to conduct research shall only be sustained subject to fulfilling all the requirements stated above.

The approval period is 20th January, 2023 – 19th January, 2024.

20/01/2023
DR. WILSON K. ARUASA, *MBS, EBS*
CHIEF EXECUTIVE OFFICER
MOI TEACHING AND REFERRAL HOSPITAL

MOI TEACHING AND REFERRAL HOSPITAL
CEO
APPROVED
20 JAN 2023
SIGN.....
P. O. Box 3-30100, ELDORET

c.c. - Senior Director, Clinical Services
- Director, Nursing Services
- HOD, HRISM

APPENDIX V: NACOSTI APPROVAL LETTER

REPUBLIC OF KENYA

NATIONAL COMMISSION FOR SCIENCE, TECHNOLOGY & INNOVATION

Ref No: 329487

Date of Issue: 02/March/2023

RESEARCH LICENSE

This is to Certify that Dr., Nicholas Kitilla of Moi University, has been licensed to conduct research as per the provision of the Science, Technology and Innovation Act, 2013 (Rev.2014) in Uasin-Gishu on the topic: CLINICOPATHOLOGIC FEATURES AND EARLY TREATMENT OUTCOMES OF TUMORS CAUSING MECHANICAL INTESTINAL OBSTRUCTION AT MOI TEACHING AND REFERRAL HOSPITAL IN ELDORET, KENYA. for the period ending : 02/March/2024.

License No: NACOSTI/P/23/23698

329487

Applicant Identification Number

Director General
NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Verification QR Code

NOTE: This is a computer generated License. To verify the authenticity of this document, Scan the QR Code using QR scanner application.

See overleaf for conditions

APPENDIX VI: BUDGET

Project: Surgical outcomes of mechanical intestinal obstruction due to neoplasms at Moi Teaching and Referral Hospital in Eldoret, Kenya			
Start Date	01-Jan-23		
End date	31-Dec-23		
Budget in Kenya shillings (Kshs)			
Salaries and wages	**Description**	**Monthly**	**Yearly**
Research Assistant		5,000	60,000
Stationery			
Box files	2 box files @250 for the study period		500
Printing papers	3 rims of paper @1000		3,000
Printing cost	Proposal, Questionnaires, Thesis		10,000
Pens	2 packets of 12 pens each @150		300
Binding	Proposal and final thesis documents		2,000
Internet and other accessories			
Internet			4,000
Computer	1 computer @45,000		45,000
Fees			
IREC	One off Payment made for review process and research approval		2000
NACOSTI	One off Payment for license to conduct the study		1,000
Manuscript writing and publication	One off payment		60,000
Miscellaneous	10% of the total budget		18,780
		Total	**206,580**