



COLLEGE OF HEALTH SCIENCES.

DEPARTMENT OF SURGERY.

**INCIDENCE AND PREDICTORS OF EARLY COMPLICATIONS FOLLOWING
AMBULATORY INGUINAL HERNIA REPAIRS AT MULAGO NATIONAL
REFERRAL HOSPITAL: A PROSPECTIVE COHORT STUDY.**

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DECLARATION

I, **Nyombi Lillian**, do hereby declare that this manuscript is my original work and has never been submitted partially or wholly for publication or award of any degree in this university or any other institution. The views expressed herein are my own unless otherwise stated, and where such has been the case, a reference has been quoted.

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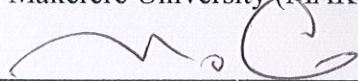
APPROVAL

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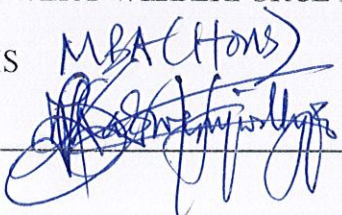
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DEDICATION

I dedicate this work to all the patients who courageously participated in this study, sharing their experiences to contribute to the advancement of medical knowledge.

Their willingness to support this research is deeply appreciated.

May this work contribute to enhancing surgical outcomes and improving care for ambulatory inguinal hernia patients.

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ACRONYMS

ASA	American Society of Anesthesia physical status grade.
BMI	Body Mass Index.
JHO -	Junior House Officer
MAK -	Makerere University
MNRH	Mulago National Referral Hospital
PI	Principal Investigator
RR	Relative Risk
SHO	Senior House Officer
SoMREC -	School of Medicine Research and Ethics Committee
SSI -	Surgical Site Infection
UNCST	Uganda National Council of Science and Technology.
VAS	Visual Analogue Scale

OPERATIONAL DEFINITIONS.

Adult in this study refers to a person with 18 completed, years and above (<https://dictionary.cambridge.org>)

Ambulatory inguinal hernia surgery in this study will be a planned inguinal hernia surgical procedure where the patient is operated upon and discharged within 24 hours or within the same day (Bailey et al 2019)

Bleeding in this study refers to loss of blood from the circulatory system within seven days after an inguinal hernia repair (Donley et al 2023), visually estimated from the number and saturation of the gauze dressings at the incision site i.e., lightly stained → ~1–2 ml, moderately soaked → ~3–5 ml, fully soaked → ~5–10 ml

Cardiovascular events in this study are heart or blood vessel related complications (i.e., stroke, arrhythmias, cardiac arrest, DVT, pulmonary embolism) that can occur in the perioperative period or within the first seven days of the post operative period (Wheyhe et al 2017).

Early Complications in this study will refer to the occurrence of any one of the following: Moderate-severe pain, Postoperative nausea and/or vomiting, bleeding/ hematoma, urinary retention, surgical site infection, and major cardiovascular events (i.e., stroke, arrhythmias, cardiac arrest, DVT, pulmonary embolism) within the first 7 days of the postoperative period.

Gauze is a thin translucent, loosely woven fabric, usually cotton or synthetic fibers, used to clean, cover and protect wounds (<https://www.steroplast.co.uk>), the standard size used in this study was four by four inches.

Hematoma is a localized collection of blood, a clot or both outside of blood vessels, resulting from vascular injury (<https://www.sciencedirect.com>)

Moderate-Severe pain visual analogue score (VAS) of 4.5cm or higher on any day of the early post-operative period (Jensen et al., 2003)

Pain refers to the unpleasant sensory and emotional experience associated with tissue damage that is reported by the patient (<https://www.iasp-pain.org>), both immediately and within seven days postoperatively.

ABSTRACT

Background: Ambulatory inguinal hernia repair is increasingly adopted worldwide due to its safety, cost-effectiveness, and potential to reduce surgical backlogs. However, data on postoperative outcomes in low-resource settings remains limited. This study assessed the incidence and predictors of early postoperative complications following ambulatory inguinal hernia repair at Mulago National Referral Hospital.

Objective: To determine the incidence and predictors of early complications following ambulatory inguinal hernia surgeries at MNRH, Uganda.

Methods: A prospective cohort study was conducted among adult patients undergoing ambulatory inguinal hernia repair. Consecutive eligible patients were enrolled and followed for seven days postoperatively. Baseline demographic and clinical characteristics, perioperative variables, and early postoperative complications were captured using a structured data tool. Logistic regression analysis was used to identify predictors of early complications, with statistical significance set at $p < 0.05$.

Results: Over a four month period, a total of 132 participants were enrolled, with males comprising most of the cohort (83.3%). The median age was 31 years (IQR: 12 years). Local anesthesia was used in all cases; Mesh repair was done for 4/132 (3%) while tissue repair was done for 128/132 (97%) patients. All repairs were done by senior house officers. Follow up period was seven days. The overall incidence of early postoperative complications was 6.8% (95% CI: 3.2%–12.6%). Postoperative nausea was the most frequent complication, 3% (4), followed by bleeding/hematoma, 1.5% (2) moderate pain, 0.8% (1) surgical site infection, 0.8% (1) and urinary retention, 0.8% (1). Other complications reported included, dizziness and numbness of the limbs especially on the side of repair. There were no mortalities. On multivariate analysis, prolonged duration of surgery was the main predictor of early complications (adjusted OR: 3.77; 95% CI: 1.21–11.71; $p = 0.022$). Other variables for instance; age, sex, and ASA classification showed positive but non-significant associations with early postoperative complications.

Conclusion: Ambulatory inguinal hernia repair had a low early complication rate of 6.8%, in a relatively young and healthy population, postoperative nausea was the most frequently encountered complication at an incidence rate of 3% and prolonged duration of surgery (> 50 minutes) was identified as the main predictor of early postoperative complications. These findings support its wider adoption in low resource settings.

CHAPTER ONE: INTRODUCTION

1.1 Background

Ambulatory or day-care surgery, defined as an operative procedure in which patients are discharged on the same day, has become an integral component of modern surgical practice globally especially in high-income countries (Cullen et al., 2009). Its growing adoption is attributed to well-documented advantages, including reduced hospital costs, shorter recovery periods, and higher patient satisfaction (Appleby, 2015; Cullen et al., 2009; Quemby & Stocker, 2013; Mattila et al., 2011).

Inguinal hernias account for 39.9–80% of all anterior abdominal wall hernias. According to literature, approximately 200,000 inguinal hernia surgeries are performed annually in Russia and Germany, more than 700,000 in the USA, 80,000 in the UK, and 100,000 in France, with approximately 20 million patients undergoing inguinal hernia surgery annually worldwide (Sazhin et al 2025)

Globally, up to 80% of hernia operations are performed as day-case procedures and demonstrate complication rates comparable to those of inpatient surgery (Hernández-Granados & Quintàns-Rodríguez, 2000; Köckerling et al., 2022; Mattila et al., 2011; International Guidelines for Groin Hernia Management, 2018; Simons et al., 2009; Saia et al., 2013).

In Sub-Saharan Africa, including Uganda, the adoption of ambulatory surgery remains limited. Barriers include the predominance of low socioeconomic status, constrained health financing, geographical disparities in healthcare access, and concerns regarding postoperative complications in settings where home-based postoperative care may be suboptimal (Alkire et al., 2015; Wismayer, 2021). Nonetheless, studies from the region indicate that day-case surgery is feasible and generally acceptable to patients (Ojo, 2010; Okeke, 2004; Usang et al., 2008). Unanwa et al cited Kyabirwa (Jinja-East Africa) surgical site's effectiveness as an ambulatory center (Unanwa et al 2024), additionally, Okeke et al showed that ambulatory surgery is well accepted in Uganda. Successful scale-up, however, requires contextual evidence on common complications and their determinants (Wismayer, 2021).

Reported postoperative complications include pain, nausea and vomiting, surgical site infection, wound dehiscence, bleeding, hematoma, recurrence, testicular atrophy, and acute urinary retention (Kim et al., 2018). Studies and systematic reviews report that early complications occur in approximately 8–10% of patients after inguinal hernia repair worldwide

(Wheyhe et al 2025) A systematic review analyzing 571,445 hernia repairs found perioperative complication rates of about 8–10% globally however, some registry data show lower rates around 2.9–8% depending on surgical technique and patient factors, additionally, complications including deaths are 100 times higher in low resource centers such as in the Sub-Saharan African region compared to those done in high income countries (Weyhe et al., 2017).

In a cohort of 510 patients undergoing ambulatory abdominal hernia repair at Kyabirwa surgical site center in Jinja -East Africa, overall complication rate was 12.8% (Kim et al 2024). Hajri et al also reported a 2.4% complication rate and no mortality in a cohort of ambulatory hernia repair surgery in Tunisia (Hajri et al., 2022).

Research on predictors of complications following ambulatory inguinal hernia repair in low-resource settings is scarce. Evidence from high-income countries indicates that complication risk may be influenced by sociodemographic factors (such as age and sex), comorbidities (e.g., diabetes mellitus), anesthesia modality, surgeon expertise, and postoperative care quality (Álvarez-Aguilera et al., 2023; Lundström et al., 2012; Matthews et al., 2007; Weyhe et al., 2017). These factors may interact differently in resource-limited environments, further emphasizing the need for local data.

This study therefore investigated the incidence and predictors of early postoperative complications within seven days following ambulatory inguinal hernia repair at Uganda's largest teaching hospital. Findings from this research are intended to inform safe expansion of ambulatory surgery as a strategy to address unmet surgical needs.

1.2 Problem Statement

Despite the well-recognized benefits of ambulatory inguinal hernia repair, its utilization in Uganda remains low due to paucity of data regarding its safety profile; especially, concerns regarding early complications which negatively affect patient outcomes.

In Uganda, inguinal hernia repair is one of the most commonly performed general surgical procedures, however there's limited local evidence on the incidence of early complications and their predictors particularly at Mulago National Referral Hospital.

In the absence of evidence on early complication rates and associated predictors within this context, healthcare providers have adopted a cautious approach, limiting the expansion of ambulatory surgical services despite substantial patient demand. Many patients present with long-standing or large inguinoscrotal hernias characterized by severe adhesions requiring

technically complex dissection, thereby increasing perioperative risk. Furthermore, postoperative home care is often unreliable, constrained by low socioeconomic conditions that limit access to adequate hygiene, appropriate wound care, and timely follow-up (Wismayer, 2021).

This study sought to address these gaps by determining the incidence and predictors of early complications following ambulatory inguinal hernia repair at Mulago National Referral Hospital, thereby providing evidence to support safe, evidence-based practice.

1.3 Study Justification and Significance

Ambulatory inguinal hernia repair has the potential to substantially reduce healthcare costs, optimize bed utilization, and improve access to essential surgical care in Uganda, benefits consistently demonstrated in international literature (Appleby, 2015; Cullen et al., 2009; Quemby & Stocker, 2013).

Generating local evidence on early postoperative outcomes and their predictors, is essential for guiding clinical decision-making, informing policy, and promoting the broader adoption of ambulatory surgery in low-resource settings. The findings of this study will be of value to surgeons, anesthetists, hospital administrators, and policymakers seeking to strengthen surgical service delivery through safe expansion of day-case procedures.

1.4 Research Questions

1. What is the incidence of early complications following ambulatory inguinal hernia repair at MNRH?
2. What factors predict early complications following ambulatory inguinal hernia repair at MNRH?

1.5 General Objective

To determine the incidence and predictors of early complications occurring within seven days following ambulatory inguinal hernia repair at MNRH.

1.5.1 Specific Objectives

1. To determine the incidence of early postoperative complications within seven days following ambulatory inguinal hernia repair at MNRH.

2. To identify predictors of early postoperative complications among patients undergoing ambulatory inguinal hernia repair at MNRH.

1.6 Conceptual framework.

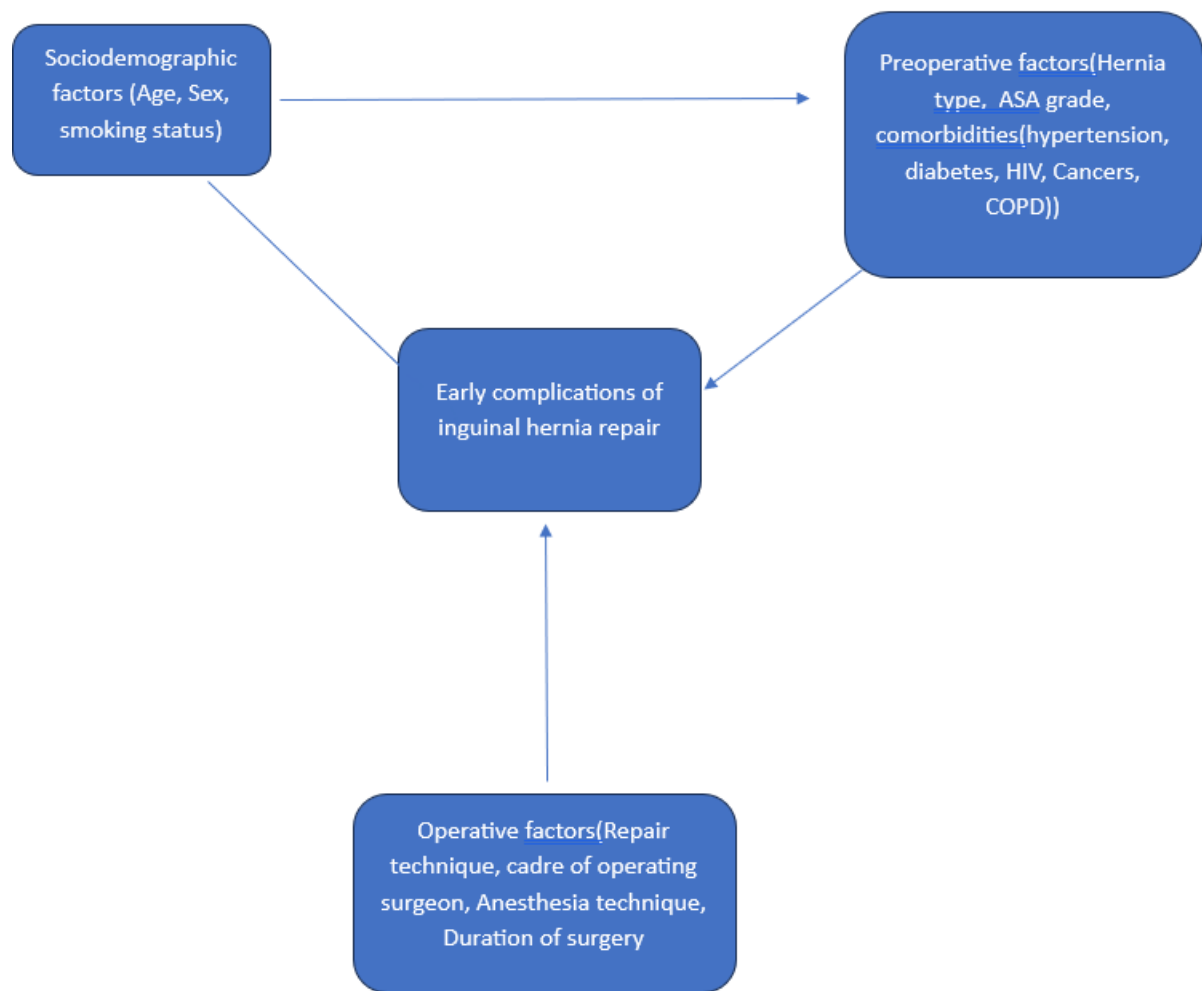


Figure 1: Conceptual frame-work.

1.7 Narrative

The occurrence of early complications following ambulatory inguinal hernia surgical procedure may be influenced by factors including sociodemographic factors (age, sex and smoking status), Preoperative clinical factors (e.g., ASA grade, hernia type), operative factors (repair technique, anesthesia technique used, cadre of primary surgeon, and the duration of the procedure). Interaction among some of these factors may confound these associations e. g., the level of expertise of surgical team may influence choice of procedure and sex may influence the type of hernia.

CHAPTER TWO: LITERATURE REVIEW

Inguinal hernia repair is one of the commonest operations performed by general surgeons worldwide. Over 800,000 repairs are performed annually (Schimitz R et al 2019). 1 million inguinal hernia repairs are performed annually in the US according to the healthcare cost and utilization project and the US Food and Drug administration data (Schlosser KA et al 2022). Galukande et al reviewed the surgical output of 8 hospitals in Uganda, Tanzania and Mozambique and found that 65% of general surgical procedures are for hernias and concluded that there is a great unmet need for hernia surgery in Africa (Galukande M, von Schreeb J, Wladis A, 2010).

Etiology of Hernia

May be acquired or congenital, where most adult ones are acquired. Genetics sometimes play a role. Patients with a known family history of hernia are 4 times likely to have an inguinal hernia. Studies show that diseases like COPD, Ehlers -Danlos syndrome, Marfan syndrome increase incidence of inguinal hernias. Also, increased intra-abdominal pressure, such as seen in obesity, chronic cough, heavy lifting, and straining due to constipation may also play a role in an inguinal hernia development (Tam, Rogers, Al-Abbas, 2019).

Epidemiology of Hernia

Inguinal hernias account for 75% of all abdominal wall hernias. The incidence of inguinal hernias has a bimodal distribution, with peaks around 5 years and after 70 years. Two-thirds of these hernias are indirect, hence indirect hernia is the most common inguinal hernia in both males and females. Males have a 90% chance of developing inguinal hernias and females about 10%.

Pathophysiology of Hernia

Studies show that inguinal hernia patients have demonstrated higher proportions of type III collagen as compared to type I. Type I collagen is associated with better tensile strength than type III. Studies have also shown that a patent processus vaginalis predisposes to the development of an inguinal hernia in adulthood. Most pediatric inguinal hernias are thought to be congenital due to a patent processus vaginalis. During normal development, the testes descend from the abdomen into the scrotum leaving behind a diverticulum that protrudes through the inguinal canal and becomes the processus vaginalis. In normal development, the

processus vaginalis closes at around 40 weeks of gestation eliminating the peritoneal opening at the internal ring. Failure of this closure can lead to an indirect hernia among children. A patent processus vaginalis does not always lead to an inguinal hernia

Presentation of Hernia

Inguinal hernias can present with a bulge or pain in the groin area which some describe as worse with physical activity or coughing. At times an inguinal hernia can present with severe pain or obstructive symptoms caused by incarceration or strangulation of the hernial sac contents.

Physical examination is the best way to diagnose a hernia, best performed with the patient standing. Visual inspection of the inguinal area is conducted first to rule out obvious bulges or asymmetry in groin or scrotum. Next, the examiner palpates over the groin and scrotum to detect the presence of a hernia. Palpation of the inguinal canal is completed last. The examiner palpates through the scrotum and towards the external inguinal ring. The patient is then instructed to cough or perform a Valsalva maneuver. If a hernia is present, the examiner will be able to palpate a bulge that moves in and out as the patient increases intraabdominal pressure through coughing or Valsalva. Examination of the contralateral side is essential as to allow the clinician to compare right versus left for symmetry and/or abnormalities.

Treatment / Management of Hernia

Surgical Repair

Surgical repair is the definitive treatment for symptomatic inguinal hernia. Can be open or laparoscopic.

Open Approach Tissue Repairs

Where the native tissue is used to close the hernia defect with suture, and no mesh is used. These repairs are used when the operative field is contaminated or in emergency surgery where the viability of the hernia contents is in question. The main primary tissue repairs are the Bassini, Shouldice and Desarda types of repairs. The Shouldice method has the lowest recurrence rate when experienced surgeons perform tissue repairs. Prosthetic repairs offer a lower incidence of recurrence over native tissue repairs.

Prosthetic Repairs

The prosthetic repairs are tension-free repairs, and therefore have a lower hernia recurrence rate as compared to tissue repairs. The prosthetic repairs are the Lichtenstein tension-free repair,

plug and patch, and Prolene Hernia System (PHS). The Prolene Hernia System repair is the only one of the 3 that places a mesh in the preperitoneal space with an open repair. Mesh repairs are contraindicated in a contaminated field due to the high rates of infection. Repairs may be done on ambulatory basis or an inpatient basis.

Treatment / Management

Surgical Repair

Surgical repair is the definitive treatment for symptomatic inguinal hernia. Can be open or laparoscopic. The main primary tissue repairs are the Bassini, Shouldice and Desarda types of repairs. The Shouldice method has the lowest recurrence rate when experienced surgeons perform tissue repairs. Prosthetic repairs offer a lower incidence of recurrence over native tissue repairs.

Ambulatory model

Ambulatory or Day-care surgery has gained significant traction in recent years due to its potential benefits, including cost-effectiveness, and patient convenience (Joyner et al., 2023; Voorbrood et al., 2015; Zhong et al., 2023). Up to 80% of all inguinal hernia repair surgeries are now being performed on an ambulatory basis in some countries (De Lange et al., 2010; Saia et al., 2013; Sanjay et al., 2006). Despite its advantages, complications can arise following ambulatory surgeries. Understanding the magnitude of these complications and their associated factors is essential for optimizing patient safety and improving the quality of healthcare delivery using the ambulatory surgery model.

2.1 Incidence of complications in Ambulatory inguinal hernia repair Surgeries.

Studies mostly in the developed world have consistently reported a low incidence of complications in ambulatory hernia surgeries and there seems to be no difference in complication rates between ambulatory and inpatient hernia repair surgeries (Joyner et al., 2023; Kumaran et al., 2022; Mattila et al., 2011; Weyhe et al., 2017; Zhong et al., 2023)

Kumaran and colleagues assessed the feasibility and outcomes of primary care ambulatory hernia repair service at a single center in the UK, they found a 2.4% complication rate in addition to lower cost of care compared to in-hospital care (Kumaran et al., 2022). Hajri et al also reported a 2.4% complication rate and no mortality in a large cohort of ambulatory hernia

surgery in Tunisia (Hajri et al., 2022). Weyhe and colleagues in a systematic review to assess perioperative complications of inguinal hernia repairs, reported an overall complication rate of only 2.9% (Weyhe et al., 2017). The study by Mattila and colleagues compared ambulatory versus inpatient inguinal hernia repairs. They found no difference in complication and readmission rates moreover the patients in the ambulatory arm had a higher procedure satisfaction rate (Mattila et al., 2011).

The incidences of complications following ambulatory hernia surgeries in Sub-Saharan Africa are overall low although significantly higher than those in the West (Obalum et al., 2008; Weyhe et al., 2017). In the systematic review by Weyhe and colleagues, complications including deaths are 100 times higher in low resource centers such as in the Sub-Saharan African region compared to those done in high income countries (Weyhe et al., 2017).

Obalum et al (2008) conducted a cross-sectional study on 72 cases of inguinal hernia managed as day case surgeries in Nigeria and reported significant post-operative pain experience in 62.5% of cases, wound infection occurred in 11.2% of the patients Hernia recurrence occurred in 1.4% cases (Obalum et al., 2008).

In a retrospective, single center study of hernia repairs at Kyabirwa Surgical Center, an ambulatory surgery center in Eastern Uganda, a total of 510 patients who underwent hernia repair had an overall complication rate of 12.8%. Hernia recurrence occurred in 1.4% cases (Obalum et al., 2008).

The higher complication rates in the sub-Saharan African region is most likely a sequel of the widespread healthcare gaps in the region.

2.2 Common Complications in Ambulatory hernia surgeries.

Postoperative pain is the commonest complication following inguinal hernia repair (Obalum et al., 2008). Mattila and colleagues in a randomized control trial that compared ambulatory and inpatient inguinal hernia repair models found no difference in pain experience between the two groups and in both models, patient satisfaction was high (Mattila et al., 2011).

Uncontrolled post-operative pain leads to delayed discharge, increased likelihood of overnight admissions, as well as patient distress and dissatisfaction after the surgery. It also affects early patient mobilization and delays in return to normal function.

The visual analogue scale measures the pain that a patient feels on a scale of 0 to 10. It's measured in centimeters running from 0 to 10cm and the patient is asked to show where his pain lies on the scale. This ranges from no pain to extreme pain.

Surgical site infection (SSI) is a cause of concern in ambulatory inguinal hernia surgeries given these patients are discharged with fresh wounds to be managed at home most likely by nonprofessionals. However, reported infection rates have been low often less than 1%. (Hernández Granados & Quintàns-Rodríguez, 2000).

Systematic review and meta-analysis consisting of 90 articles assessing the prevalence of surgical site infection in day-care surgery found a low prevalence of SSI (1.36%) (Pivot et al., 2019). Reported surgical site infection rates in the developing world is slightly higher. Cai et al reported a 4.1% SSI rate in a systemic review of studies done in low- and middle-income countries (Cai et al., 2018). A study in Pakistan on day case hernia surgeries reported a 7.7% SSI rate (Pardhan et al., 2013)

Postoperative nausea and vomiting can occur in ambulatory inguinal hernia operations; especially in the immediate postoperative period, and more in those done under general anesthesia (Bajwa et al., 2017). Palumbo et al evaluated postoperative nausea and vomiting (PONV) among 910 outpatient inguinal hernia repair surgeries. They reported an overall 7.5% incidence of PONV. The incidence was significantly higher among cases that received intraoperative opioid analgesics (remifentanyl & fentanyl); no PONV among those given intraoperative propofol in this study. The authors argued this could be due to antiemetic effect of the latter drug (Palumbo et al., 2018).

The Occurrence of major cardiopulmonary complications (dysrhythmias, myocardial infarction, heart failure, and angina) following ambulatory inguinal hernia surgery is now rare in developed countries due to improvements in anesthetic techniques, preoperative patient preparation, and selection. In a systemic review consisting of 39 publications and over 570,000 inguinal hernia surgeries, major cardiovascular events in only 0.2% of cases were reported (Weyhe et al., 2017). In the developing world where it is almost certain that ambulatory surgery theatres are less well-equipped, surgeons and anesthetic teams should be mindful of these complications.

Postoperative urinary retention occurs in 0.2–25% of patients after inguinal hernia repair (Hudak et al., 2015). The etiology is multifactorial and its occurrence in ambulatory surgeries

often leads to unplanned admissions, discomfort, need for invasive catheterizations, and increased costs (Šeparović & Augustin, 2017).

Known preoperative risk factors for urine retention include age over 50 years, perioperative narcotic use, operative duration greater than 2 hours, pre-existing neurologic diseases e.g. spinal lesions, diabetic, and alcoholic neuropathy (Baldini et al., 2009; Hudak et al., 2015; Patel et al., 2015), pre-existing bladder outlet obstruction (e.g. Benign prostate hyperplasia) and unilateral versus bilateral hernia repair (Hudak et al., 2015; Sivasankaran et al., 2014).

Recurrence of inguinal hernia is uncommon in the early postoperative period and when this does occur; it is often due to deep surgical site infection, tissue ischemia and necrosis and/or excessive tension at repair site (Frankel & Burney, 2010)

Other complications known to occur in the setting of ambulatory inguinal hernia surgery include bleeding/ hematoma formation (Weyhe et al., 2017), and anesthesia complications (Dizziness, aspiration/ airway reaction) (Kala & Sharma, 2018; Kim et al., 2013).

2.3 Predictors of early complications of ambulatory inguinal hernia surgery

Evidence from the developed world indicates that the outcomes of ambulatory surgeries in general are influenced by factors such as patient characteristics (such as age, sex ,body mass index ,smoking), surgical complexity, preoperative patient's health status, anesthesia techniques used, surgical expertise, quality of postoperative care, and the unique challenges posed by the varying healthcare environments around the globe (Alharthi et al., 2022; Chung et al., 1999; Gan et al., 2007; Mathis et al., 2013; Mattila et al., 2005; Whippey et al., 2013). The following studies highlight some of the factors known to influence complications in ambulatory inguinal hernia repair surgeries.

Weyhe et al (2017) conducted a systemic review to assess risk factors for perioperative complications of inguinal hernia surgeries. A total of 39 studies and 571,445 hernia repair cases were evaluated in this study. They found several significant predictors for complications including the type of anesthesia, emergency operation, bilateral hernia repair, advanced patient age, Higher ASA grades, presence of diabetes mellitus, current smoking status and surgery in low resource setting (Weyhe et al., 2017).

Lundstrom and colleagues analyzed a Swedish national data base of over 1500 inguinal hernia repairs, aiming at identifying risk factors for postoperative complications. The study identified the following factors as high risk for complications in ambulatory inguinal hernia repairs: Age

greater than 65 years, duration of surgery exceeding 50 minutes, operation under general or spinal anesthesia, emergency inguinal hernia repairs, recurrent hernia and laparoscopic or open pre-peritoneal technique versus open anterior mesh repair technique (Lundström et al., 2012).

A report from the analysis of the veteran's affair cooperative program hernia study trial data indicated that, for both the laparoscopic and open hernia repair techniques, complications are increased for hernias that are categorized as complex (i.e., those that are large extending to scrotum), and recurrent hernia repairs. Also significant in this analysis is that complications were substantially higher in the laparoscopic group than the open inguinal hernia repair group (Matthews et al., 2007).

Alvarez-Aguilera et al (2023) performed an analysis on prospectively collected data on 743 groin hernia surgeries. They compared those cases operated on an outpatient basis to those that were admitted. They found the likelihood of a morbidity requiring admission was higher among the male gender, open inguinal hernia repair technique, bilateral hernia repairs, and repairs of recurrent hernias (Álvarez-Aguilera et al., 2023).

2.4 Gap in literature

The concept of ambulatory surgery is increasing in popularity among the medical community in Uganda. However, confidence in the model is based on the safety reports mainly from the developed World. The incidence of complications and their predictors following ambulatory inguinal hernia repair in Uganda has not been formally evaluated. Given the gaps in healthcare services between developed and developing nations like Uganda, local evidence on the safety of ambulatory inguinal hernia surgery will be key in designing evidence-based guidelines tailored to the needs of the local population.

CHAPTER THREE: METHODOLOGY.

3.1 Study design.

This study was a prospective cohort study.

3.2 Study Period.

The study assessed ambulatory inguinal hernia surgeries performed at MNRH from November 2024 to February 2025. During this period, data was collected on patient demographics, clinical characteristics, surgical techniques, and postoperative outcomes occurring within seven days, to determine the incidence and predictors of early complications.

3.3 Study site.

The study was conducted at the general surgical outpatient units of Mulago National Referral Hospital. MNRH is the National Referral Hospital for Uganda, and it doubles as a teaching hospital for Makerere University College of Health Sciences.

The hospital is located on Mulago Hill in the Northern part of the city of Kampala, immediately to the west of the Makerere University, College of Health Sciences. It is approximately 5 kilometers, Northeast of Kampala's central business district. The Hospital has an estimated bed capacity of approximately 1800 beds (“Mulago National Referral Hospital/EA Health” www.eahealth.org. Retrieved 2nd October 2025) and provides general as well as specialized medical and surgical services for the Kampala metropolitan population and all patients referred from all other regions in the country.

At MNRH, general surgery outpatient unit operates 5 days a week. On average, 10 ambulatory inguinal hernia repairs among others are done at the unit per week by a team of consultant surgeons, senior house officers, and/or Junior House Officers (interns). These cases are discharged soon after the procedure if they are stable; and then followed up daily for period of 7 days to assess their recovery course.

3.4 Population

3.4.1 Target population.

The target population for this study included all adult patients (18 years or older) undergoing ambulatory inguinal hernia repair in Uganda.

3.4.2 Accessible population.

The accessible population for this study consisted of adult patients (18 years or older) undergoing ambulatory inguinal hernia surgeries at MNRH.

3.4.3 Study population.

The study population consisted of adult patients (18 years or older) undergoing ambulatory inguinal hernia surgeries at MNRH during the study period and met the eligibility criteria.

3.5 Eligibility criteria.

3.5.1 Inclusion criteria.

The inclusion criteria for this study were adult patients (18 years or older) who underwent ambulatory inguinal hernia surgeries at MNRH between November 2024 and February 2025 and provided informed consent to participate in the study.

3.5.2 Exclusion criteria.

1. Emergency inguinal hernia repairs as these cases may involve additional complications and are likely to require inpatient care.
2. Other groin hernias e.g. obturator hernia, femoral hernias.
3. Giant Inguinal hernia
4. Bilateral inguinal hernia
5. Comorbidities for instance; COPD, LUTS

3.6 Study variables

3.6.1 Independent variables

Age (completed years)

Sex (male, female).

ASA grade (I, II, III, IV)

Duration of procedure (in hours)

Type of hernia (inguinal, inguinal scrotal,)

Smoking (None, previous, current-smoker).

Anesthesia technique (local, regional, or general)

Hernia repair technique (tissue repair, mesh repair)

Cadre of operating surgeon (JHO, SHO, Consultant)

3.6.2 Dependent variables

Early complications (Any one of; bleeding/hematoma, urinary retention, PONV, SSI,

Cardiovascular events, and moderate to severe pain) (yes or no)

3.7 Sampling strategy.

3.7.1 Sampling technique.

Consecutive sampling technique was used to recruit patients in this study.

3.7.2 Sample size estimation

For objectives one.

We used the following formula,

$$n = \frac{Z^2 P(1 - P)}{D^2}$$

Where:

n: Required sample size.

Z: The standard normal Z-score corresponding to a 95% confidence interval = 1.96

P: Estimated incidence of complication following ambulatory inguinal hernia surgery from previous study (Lundström et al., 2012) (i.e., 8% or 0.08)

D: required precision of the estimate =0.05

Substituting for all in the above formula gives a sample size of 113.1

For objective two:

The sample size formula for comparing two proportions (Charan & Biswas, 2013):

$$\text{Sample size} = \frac{2(Z_{\alpha/2} + Z_{\beta})^2 P(1 - P)}{(p_1 - p_2)^2}$$

Where: *Z* $\alpha/2$: The standard normal Z-score corresponding to a 95% confidence interval = 1.96

*Z*_B: standard normal Z score corresponding to 80% power of study= 0.84

P₁ and P₂: Proportions of complications between 2 groups (recurrent and non-recurrent hernia repair) from a previous study (Lundström et al., 2012): P₁ = 0.121, P₂ = 0.078)

$$P^* = (P_2 + P_1) = 0.0995$$

Substituting for all in the above formula gives a sample size of 757

Taking the largest of the 2 sample sizes, the sample size for this study will be **757 participants**, however the expected number of hernia surgeries during the study period will be **160** cases.

Using Cochran's equation (below) for small populations of known size (finite population);

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

Where n is the adjusted sample size; n₀ is the calculated sample size = 757

N is the finite population = 160

The adjusted sample size for this study will be **132 participants**

3.8 Study procedure.

Data collection was carried out by a team of prior trained research assistants (medical officers) who were prepared by the principal investigator. The training focused on taking a brief but focused history, performing examinations for inguinal hernia, and distinguishing hernias from other swellings. The research assistants screened eligible patients on the day of their surgery. Those who met the study's inclusion criteria were consented, assessed, and recruited into the study.

A pretested questionnaire was used for the assessment and data collection. The data points obtained from each study participant included:

- Sociodemographic and preoperative factors: Age, sex, ASA score, smoking status, and hernia characteristics including the type and size.
- Operative factors: Anesthetic technique used, cadre of the primary surgeon, repair technique used, presence of comorbidities and any intraoperative complications.
- Postoperative Data: Patients were followed up to assess recovery and the occurrence of complications. Assessments were conducted in the immediate postoperative period (before discharge) and within 7 days of the postoperative period. Pain was assessed using the Visual

Analog Scale (VAS), (Hawker et al., 2011). The surgical site was examined for infection, hematoma, tenderness and dehiscence daily within a period of 7 days.

Patients were required to void before leaving the hospital as an assessment for urine retention.

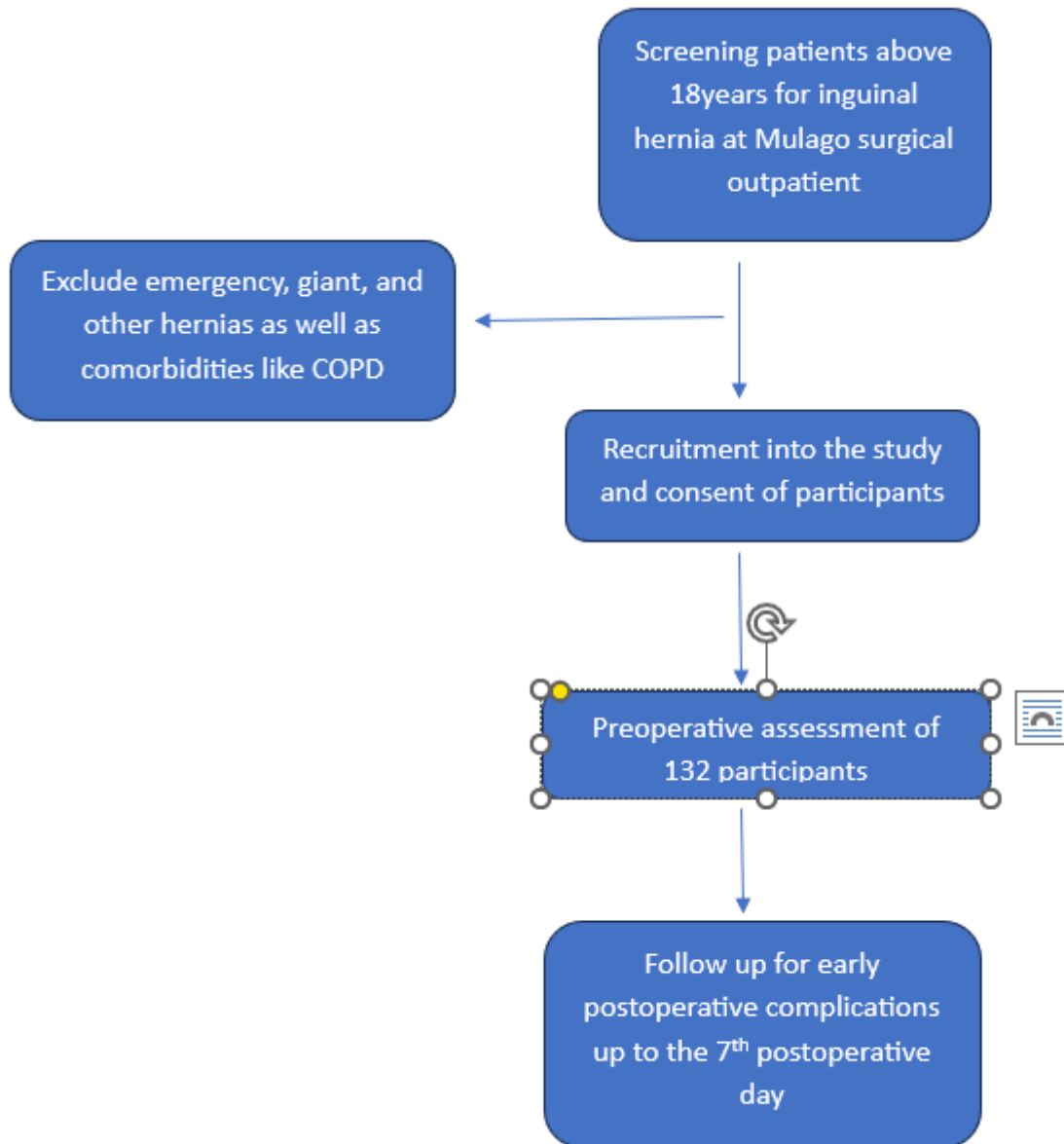


Figure 2: Patient flow chart. (MNRH; Mulago National Referral Hospital).

3.9 Data management and analysis

All study data were entered into a Microsoft Excel document, cleaned, and then exported to STATA version 18 (STATACORP, Texas, USA) for analysis. Continuous variables were summarized as means and standard deviations for normally distributed data, while medians and interquartile ranges were used for non-normally distributed variables. Categorical variables were summarized using absolute frequencies and percentage proportions.

The results were presented in the form of tables, charts, and graphs.

3.9.1 Data analysis for objective one

The overall incidence of complications among ambulatory inguinal hernia surgery patients at MNRH was estimated as a proportion (in percentages) of patients who experienced at least one complication following the surgery, divided by the total number of participants evaluated in the study. Similarly, the incidence of each specific complication was calculated as a proportion of patients who experienced that particular complication, divided by the total number of evaluated patients.

3.9.2 Data analysis for Objective two.

At the univariable level of analysis, differences in outcomes (i.e., occurrence of any complication) were evaluated between categorical independent variables using the Chi-square test or Fisher's exact test, depending on the expected frequencies. For continuous independent variables, Mann-Whitney U-test was used to compare median between groups.

All variables with a p-value of < 0.2 in the univariable analysis were subsequently included in the multivariable analysis to identify independent predictors of early complications. The multivariable logistic regression model was used to adjust for potential confounders and assess the strength of association between predictors and complications.

All analyses were two-sided, with $p < 0.05$ considered statistically significant. Results were reported in odds ratios with 95% confidence intervals to quantify the risk of complications associated with each predictor.

3.10 Quality assurance and control

To ensure completeness and accuracy, data entry into the electronic form (Microsoft Excel document) was conducted immediately on the day of data collection from each patient. Data entry was performed by two independently operating research assistants to minimize errors and enhance reliability.

The PI reviewed the data entries on a daily basis, promptly resolving any discrepancies and addressing missing data to maintain data integrity.

3.11 Ethical consideration.

Ethical approval to conduct this study was obtained from the School of Medicine Research and Ethics Committee (SoMREC) of Makerere University; Mak- SOMREC-2024-1006 and the Uganda National Council of Science and Technology (UNCST). Before recruitment into the study, informed written consent was obtained from each participant to ensure voluntary participation and ethical compliance. Participants who declined to participate in the study were still offered standard routine care according to the hospital's guidelines.

All cases with complications were managed and/or referred for appropriate care to safeguard participant safety and well-being. To ensure confidentiality, the identities of study participants were not included in the study data. Instead, unique study numbers were assigned to each participant's file. Additionally, hard copies of data were securely stored under lock and key, while electronic forms of the data were password-protected to maintain data safety and confidentiality.

3.12 Study dissemination.

The outcomes of this study were presented in the form of a dissertation to the Directorate of Graduate Studies of Makerere University, fulfilling the requirements for the award of Master of Medicine in Surgery. Copies of the dissertation were also provided to the Department of Surgery, the Directorate of Research and Graduate Studies, and the Albert Cook Library.

The findings were shared with relevant authorities at MNRH and the Ministry of Health (Uganda) to inform healthcare policies and support evidence-based decision-making. Additionally, the study is intended to be published in a reputable peer-reviewed journal to contribute to the global body of knowledge on ambulatory hernia surgeries and enhance clinical practice guidelines.

CHAPTER FOUR: RESULTS

4.1 Baseline Patient Characteristics

A total of 132 patients who underwent ambulatory inguinal hernia repair were included in this study. The majority were male (83.3%, n=110). The median age of participants was 31 years (IQR = 12).

Most participants were non-smokers (87.9%, n=116), while 5 (3.8%) were former smokers and 11 (8.3%) were current smokers.

Regarding preoperative physical status, 113 patients (85.6%) were classified as ASA grade I, while 19 (14.4%) were ASA grade II.

Tissue repair was the predominant surgical technique, performed in 128 patients (97.0%), whereas mesh repair was used in 4 patients (3.0%) (**Table 1**).

4.2 Incidence of Early Complications

The overall incidence of early postoperative complications following ambulatory inguinal hernia repair was 6.8% (95% CI: 3.2–12.6).

The most frequently encountered complication was postoperative nausea (3%), there was no vomiting. Other complications included: Bleeding/hematoma: 2 cases (1.5%); Moderate to severe pain: 1 case (0.8%); Surgical site infection (SSI): 1 case (0.8%); and Urinary retention: 1 case (0.8%) (**Figure 3**).

Table 1: A summary of the baseline characteristics of the study population.

Variables	Frequency (n)	Percentage (%)
Age (years); Median (IQR)	31 (28 – 40)	
Sex		
Female	22	16.7
Male	110	83.3
ASA grade		
I	113	85.6
II	19	14.4
Smoking status		
Non-smoker	116	87.9
Previous-smoker	5	3.8
Current-smoker	11	8.3
Hernia type		
Inguinal	125	94.7
Inguino-scrotal	7	5.3
Hernia repair technique		
Tissue repair	128	97.0
Mesh repair	4	3.0
Anaesthetic technique		
Local anaesthetic infiltration	132	100
Sedation plus local infiltration	0	0.0
Spinal anaesthesia	0	0.0
General anaesthesia	0	0.0
Cadre of primary surgeon		
JHO/Medical officers	0	0.0
SHO	132	100
Consultants	0	0.0
Duration of surgery (hours); median (IQR)	1.5 (1 – 2)	

ASA-American Society of Anaesthesia physical status grade; CI-Confidence interval; ^b-any one of cardiovascular disease, hypertension or Diabetic mellitus; JHO: Junior House Officer, SHO: Senior House officer.

Figure 3: Graph showing age groups

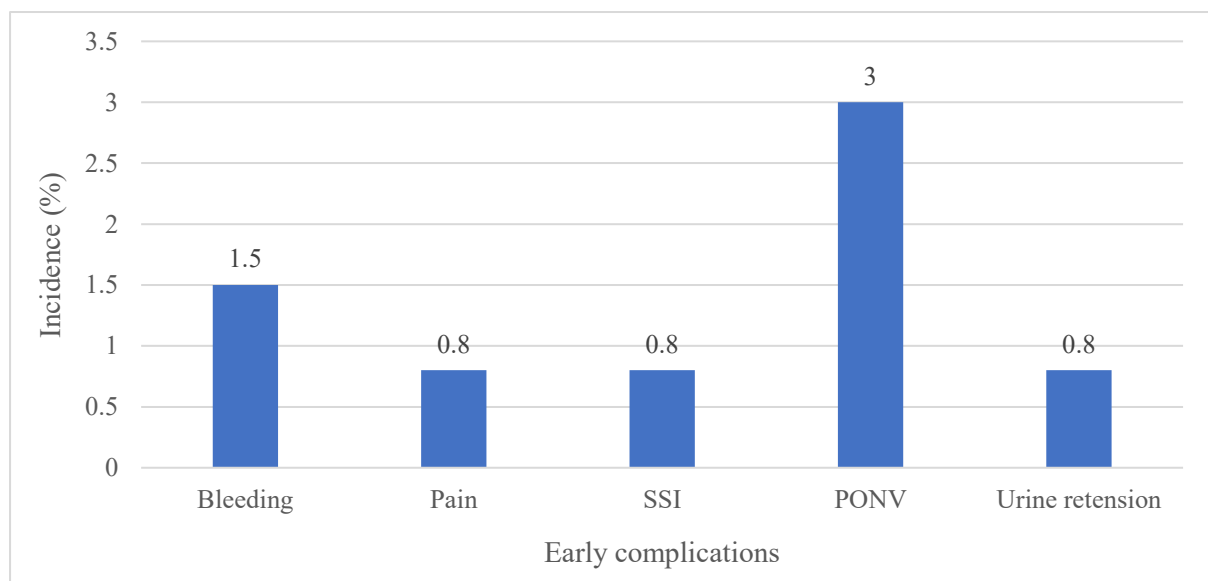
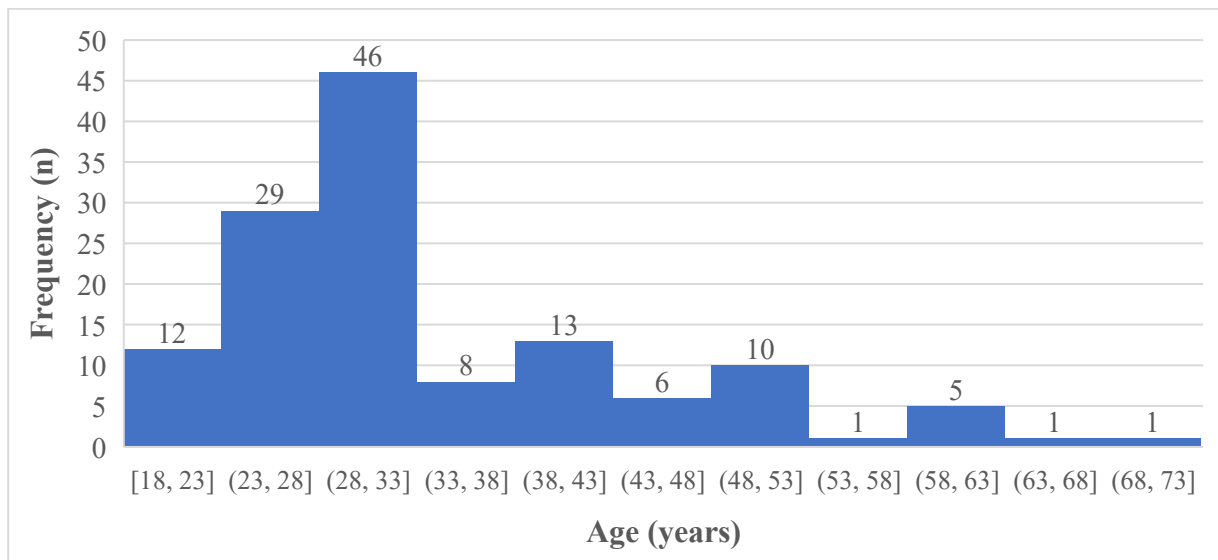


Figure 4: Incidences of specific early complications following ambulatory inguinal hernia surgery at MNRH.

4.3 Predictors of Early Complications

In the univariable analysis, several factors demonstrated associations with early postoperative complications at a significance level of $p < 0.20$. These included: - Increasing age ($p = 0.03$), Male sex ($p = 0.172$), ASA grade status ($p = 0.121$), Increasing duration of surgery ($p = 0.096$) (**Table 2**).

Table 2: Univariable analysis of factors predicting early complications following Ambulatory inguinal hernia surgeries at MNRH.

Variables	No complication	complication	p-value
Age (years); Median (IQR)	30.0 (28 – 40)	42 (32 – 47)	0.030
Sex			0.172
Female	19 (86.4)	3 (13.6)	
Male	104 (94.5)	6 (5.5)	
ASA grade			0.121
I	107 (94.7)	6 (5.3)	
II	16 (84.2)	3 (15.8)	
Smoking status			0.299
None-smoker	109 (94.0)	7 (6.0)	
Previous-smoker	4 (80.0)	1 (20.0)	
Current-smoker	10 (90.9)	1 (9.1)	
Hernia type			1.000
Inguinal	116 (92.8)	9 (7.2)	
Inguino-scrotal	7 (100)	0 (0.0)	
Hernia repair technique			0.249
Tissue repair	120 (93.7)	8 (6.3)	
Mesh repair	3 (75.0)	1 (25.0)	
Anaesthetic technique			1.000
Local anaesthetic infiltration	123 (93.2)	9 (6.8)	
Sedation plus local infiltration			
Duration of surgery (hours); median (IQR)	1.5 (1 – 2)	2 (1 – 3)	0.096

In the multivariable analysis, after adjusting for confounders, duration of surgery remained the only statistically significant predictor of early complications. The odds of developing an early postoperative complication more than tripled with each additional hour of operative time (adjusted OR = 3.77; 95% CI: 1.21–11.71; p = 0.022).

Age, sex and ASA grade showed positive but non-significant associations with early postoperative complications (**Table 3**).

Table 3: Multivariable analysis of factors predicting early postoperative complications following ambulatory inguinal hernia repairs at MNRH.

Variables	Adjusted Odds ratio (95% CI)	p-value
Age (years)	1.02 (0.95 – 1.10)	0.596
Sex		
Male	Reference	
Female	2.71 (0.54 – 13.58)	0.225
ASA grade		
I	Reference	
II	1.51 (0.14 – 15.89)	0.730
Duration of surgery (hours)	3.77 (1.21 -11.71)	0.022*

CHAPTER FIVE: DISCUSSION

This prospective cohort study examined the incidence and predictors of early complications following ambulatory inguinal hernia repairs at MNRH. The overall early complication rate of 6.8% aligns with global evidence demonstrating that ambulatory inguinal hernia repair is a safe and effective surgical approach (Lau & Lee, 2000; El Morsy et al., 2002; Padungpakdeewong et al., 2018; Hajri et al., 2022). Lau and Lee (2000), for instance, reported a morbidity rate of approximately 5% in their day-case hernia series, with urinary retention and wound-related complications being the most common. Similarly, a large Tunisian prospective analysis found a morbidity rate of 2.7% and no mortality following ambulatory hernia repair (Hajri et al., 2022). The concordance of these findings with the present study reinforces the safety of ambulatory surgical services even within resource-constrained environments such as Uganda.

The low complication rate could be attributed to several factors such as; the meticulous preoperative assessment, screening and selection done by the operating surgeons at MNRH SOPD, which enabled relatively fit patients to be operated upon.

Secondly, complex hernias, such as recurrent hernias or large/giant hernias were referred for in patient care.

Lastly, younger patients (less than 70 years of age) were operated upon. Younger patients typically have faster recovery and better wound healing, as compared to older patients who are associated with poorer outcomes, are more likely to suffer comorbidities and have longer recovery times (Hui_Shan Lin et al 2016).

Tissue repair was the predominant surgical technique employed in this cohort. Although mesh repair is widely recognized for its lower recurrence rates in high-income settings, the low early complication rate observed in this study suggests that tissue-based techniques remain a safe and acceptable alternative when mesh availability is limited. This finding supports the continued use of resource-appropriate surgical methods, especially in low-resource settings where cost and supply constraints may restrict access to prosthetic materials

The complications were graded as moderate to severe, Clavien-Dindo score I and II (Clavien P 1992), the patients needed no hospitalization and were managed as outpatients. There were no deaths reported.

Postoperative nausea (3%) emerged as the most frequent complication in this cohort; there was however no vomiting reported. Graded as 1 and 2, this observation mirrors global data

indicating that PONV remains one of the most common adverse events following ambulatory surgery (Bajwa et al., 2017; Palumbo et al., 2018), this is lower than that reported by Palumbo et al at 7.5%.

The low rates of PONV in this study could be attributed to preoperative risk assessment and fasting protocols (Daniel C et al 2022). Known risk factors for PONV include; young to middle-aged, non-smoking females with a history of PONV or motion sickness, the use of inhalational anesthesia agents, prolonged surgery (more than 3 hours), use of nitrous oxide, and the postoperative need for opioids (Daniel C et al 2022). Although PONV is typically self-limiting, its occurrence may delay discharge, reduce patient satisfaction, and increase unplanned admissions.

Bleeding/hematoma (1.5%) aligned with global rates (1.05%, Weyhe et al., 2017), with no identifiable cause but possible links to surgical technique or adrenaline use in local anesthesia. The reported cases had dressings soaked in blood, they never required admission and were managed as outpatients, with improvement.

Post-operative pain (0.8%) was lower than the 65% reported by Oballum et al. (2008). Pain is often underestimated and inadequately treated according to Brown (Brown D 2004). The low levels in this study were due to administration of pain medication both during and after the surgery. Non-steroidal anti-inflammatory drugs were the commonest pain medications used, and the pain scales in most cases, were less than 5 according to the VAS.

SSI (0.8%) was comparable to high-income settings (<1%, Hernández-Granados & Quintàns Rodríguez, 2000) but lower than other low-resource settings (4.1–7.7%, Cai et al., 2018; Pardhan et al., 2013, Pivot et al 2019), likely due to aseptic techniques and use of better antibiotics. The relationship between SSI and DM was not easily apparent in this study as there was only 1 case of post-operative infection and he was not diabetic.

Urinary retention (0.8%) was lower than reported ranges (0.2–25%, Hudak et al., 2015; Patel et al., 2015), possibly due to the absence of risk factors like older age or bladder outlet obstruction. No clear reason could be found for the patient who reported urine retention, and this was cleared without need for invasive catheterization.

The low incidence of complications observed contradicts reports from Sub-Saharan Africa, where higher rates are noted (Obalum et al., 2008). This discrepancy may be due to, the relatively young patient age (mean age was 31 years), as younger patients' bodies recover faster, have better wound healing and better coping mechanisms.

Predictors of Early Complications

Previous studies have reported significant associations between patient-related factors and adverse postoperative outcomes (Weyhe et al., 2017; Alvarez-Aguilera et al., 2023; Lundström et al., 2012).

The findings of this study are consistent with global literature that identifies patient characteristics (e.g., sex and age), and surgical duration as significant predictors of complications (Lundström et al., 2012; Weyhe et al., 2017).

However, in this study, patient age, sex, and ASA classification showed positive but non-significant associations with early complications, while **prolonged duration of surgery** was identified as the main predictor of early complications. This is consistent with findings from the Swedish Hernia Register, where Lundström et al. (2012) reported that procedures lasting more than 50 minutes were significantly associated with higher rates of postoperative complications.

Longer operating times often reflect increased technical complexity, surgeon inexperience, difficult intraoperative anatomy, or systemic inefficiencies (Lundström et al 2012)

Study limitations

The relatively small sample size may have reduced the ability to detect significant predictors of complications.

Additionally, the single-center nature of the study may limit generalizability to other settings with differing patient populations or perioperative systems.

CHAPTER SIX: CONCLUSION

1. This study demonstrated that ambulatory inguinal hernia repair had a low early complication rate of 6.8% in relatively healthy and younger adult patients.

2. Postoperative nausea was the most frequently encountered complication at an incidence rate of 3%, consistent with international trends in ambulatory surgery.

3. Prolonged duration of surgery was identified as the main predictor of early postoperative complications.

6.2 Recommendations.

Future Research: Conduct further multicenter studies with larger sample sizes and longer follow up periods to validate these findings and assess generalizability across diverse settings.

Patient selection: Carefully select patients who are relatively young and who have no comorbidities or whose comorbidities are controlled.

REFERENCES

- Alharthi, A. A., Mohammed, A., Jamil, M., Mehboob, A., & Huda, A. U. (2022). Evaluation of risk factors for unanticipated hospital admission following ambulatory surgery—An observational study. *Saudi Journal of Anaesthesia*, 16(4), 419.
- Alkire, B. C., Raykar, N. P., Shrimel, M. G., Weiser, T. G., Bickler, S. W., Rose, J. A., Nutt, C. T., Greenberg, S. L., Kotagal, M., Riesel, J. N., Esquivel, M., Uribe-Leitz, T., Molina, G., Roy, N., Meara, J. G., & Farmer, P. E. (2015). Global access to surgical care: a modelling study. *Lancet Glob Health*, 3(6), e316-323. [https://doi.org/10.1016/s2214109x\(15\)70115-4](https://doi.org/10.1016/s2214109x(15)70115-4)
- Álvarez-Aguilera, M., DeJesús-Gil, Á., Sánchez-Arteaga, A., Tinoco-González, J., SuárezGrau, J., Tallón-Aguilar, L., & Padillo-Ruiz, J. (2023). Implementing an outpatient surgical management in moderated-high risk patients with groin hernia repair. *Hernia*, 27(5), 1307-1313.
- Appleby, J. (2015). Day case surgery: a good news story for the NHS. *Bmj*, 351, h4060. <https://doi.org/10.1136/bmj.h4060>
- Bajwa, S. J. S., Sharma, V., Sharma, R., & Singh, A. P. (2017). Anesthesia for day-care surgeries: Current perspectives. *Medical Journal of Dr. DY Patil University*, 10(4), 327-333.
- Baldini, G., Bagry, H., Aprikian, A., Carli, F., Warner, D. S., & Warner, M. A. (2009). Postoperative urinary retention: anesthetic and perioperative considerations. *The Journal of the American Society of Anesthesiologists*, 110(5), 1139-1157.
- Brown D. A literature review exploring how healthcare professionals contribute to the assessment and control of postoperative pain in older people. *Journal of Clinical Nursing*. 2004; 13:74-90.
- Cai, L. Z., Foster, D., Kethman, W. C., Weiser, T. G., & Forrester, J. D. (2018). Surgical Site Infections after Inguinal Hernia Repairs Performed in Low-and Middle-Human Development Index Countries: A Systematic Review. *Surgical Infections*, 19(1), 11-20.

- Charan, J., & Biswas, T. (2013). How to calculate sample size for different study designs in medical research? *Indian journal of psychological medicine*, 35(2), 121-126.
- Chung, F., Mezei, G., & Tong, D. (1999). Pre-existing medical conditions as predictors of adverse events in day-case surgery. *British Journal of Anaesthesia*, 83(2), 262-270.
- Clavien P, Sanabria J, Strasberg S. Proposed classification of complication of surgery with examples of utility in cholecystectomy. *Surgery*. 1992; 111:518–526. [\[PubMed\]](#) [\[Google Scholar\]](#)
- Cullen, K. A., Hall, M. J., & Golosinskiy, A. (2009). Ambulatory surgery in the United States, 2006. *Natl Health Stat Report* (11), 1-25.
- Daniel C. Sizemore; Abhishek Singh; Anterpreet Dua; Karampal Singh; Brian W. Grose. November 9, 2022 Postoperative Nausea
- De Lange, D., Kreeft, M., Van Ramshorst, G., Aufenacker, T., Rauwerda, J., & Simons, M. (2010). Inguinal hernia surgery in the Netherlands: are patients treated according to the guidelines? *Hernia*, 14, 143-148.
- Donley E, Sunil Munakomi, Loyd J W, (2023). Hemorrhage control, [http://www.ncbi.nlm.nih.gov >books](http://www.ncbi.nlm.nih.gov/books)
- El-Morsy, A. M., El Sayed, A. A. S., & Moussa, M. H. (2002). Ambulatory inguinal hernia repair. *The Egyptian Journal of Surgery*, 21(2), 900-907.
- Estridge, P., Sanders, D. L., & Kingsnorth, A. N. (2019). Worldwide hernia repair: variations in the treatment of primary unilateral inguinal hernias in adults in the United Kingdom and in low- and middle-income countries. *Hernia: the journal of hernias and abdominal wall surgery*, 23(3), 503–507. <https://doi.org/10.1007/s10029-019-01960-6>
- Fall B, Betel ME, Diarra O, Ba M, Dia A, Diop A. Complications of treatment of adult's groin hernia: a report of 100 cases comparative study between Bassini and MacVay's techniques. *Dakar Med*. 2005; 50: 37–40.
- Frankel, T. L., & Burney, R. E. (2010). Chapter 40. Inguinal Hernia Repair. In R. M. Minter & G. M. Doherty (Eds.), *Current Procedures: Surgery*. The McGraw-Hill Companies. accesssurgery.mhmedical.com/content.aspx?aid=6563581

- Galukande M, von Schreeb J, Wladis A, et al. Essential surgery at the district hospital: a retrospective descriptive analysis in three African countries. *PLoS Med.* 2010;7: e1000243.
- Gan, T. J., Meyer, T. A., Apfel, C. C., Chung, F., Davis, P. J., Habib, A. S., Hooper, V. D., Kovac, A. L., Kranke, P., & Myles, P. (2007). Society for Ambulatory Anesthesia guidelines for the management of postoperative nausea and vomiting. *Anesthesia & Analgesia*, 105(6), 1615-1628.
- Hajri, M., Haddad, D., Zaafour, H., Cherif, M., Zouaghi, A., Khedhiri, N., Mrabet, A., & Maamer, A. B. (2022). Ambulatory hernia repair: a study of 1294 patients in a single institution. *Pan African Medical Journal*, 42(1).
- Hawker, G. A., Mian, S., Kendzerska, T., & French, M. (2011). Measures of adult pain: Visual Analog Scale for Pain (VAS Pain), Numeric Rating Scale for Pain (NRS Pain), McGill Pain Questionnaire (MPQ), Short-Form McGill Pain Questionnaire (SF-MPQ), Chronic Pain Grade Scale (CPGS), Short Form-36 Bodily Pain Scale (SF-36 BPS), and Measure of Intermittent and Constant Osteoarthritis Pain (ICOAP). *Arthritis Care Res (Hoboken)*, 63 Suppl 11, S240-252. <https://doi.org/10.1002/acr.20543>
- Hernández-Granados, P., & Quintàns-Rodríguez, A. (2000). Early complications in tension free hernioplasty: comparison between ambulatory and short-stay surgery. *Hernia*, 4, 238-241.
- Hudak, K. E., Frelich, M. J., Rettenmaier, C. R., Xiang, Q., Wallace, J. R., Kastenmeier, A. S., Gould, J. C., & Goldblatt, M. I. (2015). Surgery duration predicts urinary retention after inguinal herniorrhaphy: a single institution review. *Surgical endoscopy*, 29, 3246-3250.
- Hui-Shan- Lin, J.N. Watts, N.M. Peel & R.E. Hubbard. Frailty and post-operative outcomes in older patients: a systematic review *BMC Geriatrics* 16, 157(2016). <https://doi.org/10.1186/s12877-016-0329-8>
- International guidelines for groin hernia management. (2018). *Hernia*, 22, 1-165.
- Jensen, M. P., Chen, C., & Brugger, A. M. (2003). Interpretation of visual analog scale ratings and change scores: a reanalysis of two clinical trials of postoperative pain. *J Pain*, 4(7), 407-414. [https://doi.org/10.1016/s1526-5900\(03\)00716-8](https://doi.org/10.1016/s1526-5900(03)00716-8)

- Joyner, J., Ayyaz, F., Cheetham, M., Briggs, T., & Gray, W. (2023). Day-case and in-patient elective inguinal hernia repair surgery across England: an observational study of variation and outcomes. *Hernia*, 27(6), 1439-1449.
- Kala, S. K., & Sharma, S. K. (2018). Day Care Surgery in Tertiary Level Hospital. *Int. J. Life. Sci. Scienti. Res*, 4(5), 1960-1968.
- Kim, J. Y., Lee, B. D., Park, S. H., & Jung, J. W. (2013). Ambulatory surgery and unanticipated admission rate. *Anesthesia and Pain Medicine*, 8(3), 199-202.
- Köckerling, F., Lorenz, R., Reinpold, W., Zarras, K., Conze, J., Kuthe, A., Lammers, B., Stechemesser, B., Mayer, F., & Fortelny, R. (2022). What is the reality in outpatient vs inpatient groin hernia repair? An analysis from the Herniated Registry. *Hernia*, 1-13.
- Kumaran, N., Bylapudi, S., Kirmani, S., Hodgson, G., Tennakoon, A., & Rao, M. (2022). Ambulatory Hernia Surgery in Primary Care. *British Journal of Surgery*, vii15-vii15.
- Lau, H., & Lee, F. (2000). An audit of the early outcomes of ambulatory inguinal hernia repair at a surgical day-care centre. *Hong Kong medical journal = Xianggang yi xue za zhi*, 6(2), 218-220.
- Lorenz, R. (2018). Ambulatory Hernia Surgery. *The Art of Hernia Surgery: A Step-by-Step Guide*, 175-181.
- Lundström, K.-J., Sandblom, G., Smedberg, S., & Nordin, P. (2012). Risk factors for complications in groin hernia surgery: a national register study. *Annals of surgery*, 255(4), 784-788.
- Mathis, M. R., Naughton, N. N., Shanks, A. M., Freundlich, R. E., Pannucci, C. J., Chu, Y., Haus, J., Morris, M., & Kheterpal, S. (2013). Patient selection for day case-eligible surgery: identifying those at high risk for major complications. *Anesthesiology*, 119(6), 1310-1321. <https://doi.org/10.1097/aln.0000000000000005>
- Matthews, R. D., Anthony, T., Kim, L. T., Wang, J., Fitzgibbons Jr, R. J., Giobbie-Hurder, A., Reda, D. J., Itani, K. M., Neumayer, L. A., & Investigators, V. A. C. S. P. (2007). Factors associated with postoperative complications and hernia recurrence for patients undergoing inguinal hernia repair: a report from the VA Cooperative Hernia Study Group. *The American journal of surgery*, 194(5), 611-617.

- Mattila, K., Toivonen, J., Janhunen, L., Rosenberg, P. H., & Hynynen, M. (2005). Post discharge symptoms after ambulatory surgery: first-week incidence, intensity, and risk factors. *Anesth Analg*, 101(6), 1643-1650.
<https://doi.org/10.1213/01.Ane.0000184189.79572.28>
- Mattila, K., Vironen, J., Eklund, A., Kontinen, V. K., & Hynynen, M. (2011). Randomized clinical trial comparing ambulatory and inpatient care after inguinal hernia repair in patients aged 65 years or older. *The American journal of surgery*, 201(2), 179-185.
- Obalum, D., Eyesan, S., Ogo, C., & Atoyebi, O. (2008). Day-case surgery for inguinal hernia: A multi-specialist private hospital experience in Nigeria. *Nigerian quarterly journal of hospital medicine*, 18, 42-44.
- Ojo, E. (2010). Day case surgery and developing countries-a review. *Nigerian journal of clinical practice*, 13(4).
- Okeke, L. (2004). Day case transurethral prostatectomy in Nigeria. *West African journal of medicine*, 23(2), 128-130.
- Padungpakdeewong, E. (2018). Immediate Outcomes of Ambulatory Inguinal Hernia Repair in Bangkok Metropolitan Administration Lat Krabang Hospital: Retrospective Study. *Vajira Medical Journal : Journal of Urban Medicine*, 62(4), 299–304. retrieved from <https://he02.tci-thaijo.org/index.php/VMED/article/view/194797>
- Palumbo, P., Usai, S., Amatucci, C., Pulli, V. T., Illuminati, G., Vietri, F., & Tellan, G. (2018). Postoperative nausea and vomiting (PONV) in outpatient repair of inguinal hernia. *Annali Italiani di Chirurgia*, 89(1), 75-80.
- Pardhan, A., Mazahir, S., Alvi, A. R., & Murtaza, G. (2013). Surgical site infection following hernia repair in the day care setting of a developing country: a retrospective review. *J Pak Med Assoc*, 63(6), 760-762.
- Patel, J. A., Kaufman, A. S., Howard, R. S., Rodriguez, C. J., & Jessie, E. M. (2015). Risk factors for urinary retention after laparoscopic inguinal hernia repairs. *Surgical endoscopy*, 29, 3140-3145.
- Pivot, D., Hoch, G., Astruc, K., Lepelletier, D., Lefebvre, A., Lucet, J.-C., Beaussier, M., Philippe, H.-J., Vons, C., & Triboulet, J.-P. (2019). A systematic review of surgical site

- infections following day surgery: a frequentist and a Bayesian meta-analysis of prevalence. *Journal of Hospital Infection*, 101(2), 196-209.
- Quemby, D. J., & Stocker, M. E. (2013). Day surgery development and practice: key factors for a successful pathway. *Continuing Education in Anaesthesia Critical Care & Pain*, 14(6), 256-261. <https://doi.org/10.1093/bjaceaccp/mkt066>
- Saia, M., Mantoan, D., Buja, A., Bertoncello, C., Baldovin, T., Zanardo, C., Callegaro, G., & Baldo, V. (2013). Increased rate of day surgery use for inguinal and femoral hernia repair in a decade of hospital admissions in the Veneto Region (north-east Italy): a record linkage study. *BMC Health Services Research*, 13, 1-7.
- Sanjay, P., Jones, P., & Woodward, A. (2006). Inguinal hernia repair: are ASA grades 3 and 4 patients suitable for day case hernia repair? *Hernia*, 10, 299-302.
- Schlosser KA, Renshaw SM, Tamer RM, Strassels SA, Poulouse BK. Ventral hernia repair: An increasing burden affecting abdominal core health. *Hernia*.2022
- Šeparović, I., & Augustin, G. (2017). Hernia in Ambulatory Surgery Centre. In *Hernia*. IntechOpen.
- Simons, M., Aufenacker, T., Bay-Nielsen, M., Bouillot, J., Campanelli, G., Conze, J., De Lange, D., Fortelny, R., Heikkinen, T., & Kingsnorth, A. (2009). European Hernia Society guidelines on the treatment of inguinal hernia in adult patients. In (Vol. 13, pp. 343-403): Springer.
- Sivasankaran, M. V., Pham, T., & Divino, C. M. (2014). Incidence and risk factors for urinary retention following laparoscopic inguinal hernia repair. *The American journal of surgery*, 207(2), 288-292.
- Unwana Abasi, Joseph Okello Damoi, Anna Turumanya Kalumuna, Angellica Giibwa, So Park, Dylan Cuva, Allen T Yu, Arthur Emoru, Moses Bakaleke Binoga, Dillan Villavisanis, Sara N Kiani, Katie Glerum, Jerome Waye, Michael Marin, Linda Zhang (March 2024). Ambulatory Surgery Center in Rural Uganda: A Novel Approach to Providing Surgical Care.

- Usang, U., Sowande, O., Adejuyigbe, O., Bakare, T., & Ademuyiwa, O. (2008). The role of preoperative antibiotics in the prevention of wound infection after day case surgery for inguinal hernia in children in Ile Ife, Nigeria. *Pediatric surgery international*, 24, 1181-1185.
- Voorbrood, C., Burgmans, J., Clevers, G., Davids, P., Verleisdonk, E., Schouten, N., & Van Dalen, T. (2015). One-stop endoscopic hernia surgery: efficient and satisfactory. *Hernia*, 19, 395-400.
- Weyhe, D., Tabriz, N., Sahlmann, B., & Usler, V.-N. (2017, 2025). Risk factors for perioperative complications in inguinal hernia repair—a systematic review. *Innovative surgical sciences*, 2(2), 47-52.
- Whippey, A., Greg Kostandoff, B., Paul, J., Ma, J., Thabane, L., & Ma, H. K. (2013). Predictors of unanticipated admission following ambulatory surgery: a retrospective case-control study Les prédictors d'une admission non anticipée apres une chirurgie ambulatoire: une étude cas-témoin rétrospective. *Can J Anesth/J Can Anesth*, 60, 675-683.
- Wismayer, R. (2021). The Way Forward for Elective Surgery in Developing Countries: Day Case Surgery. *New Frontiers in Medicine and Medical Research Vol. 14*, 87-96.
- Zhong, Y., He, M., Liu, Z., Chen, J. Y., Lv, X. J., Liu, M., Wen, A. P., Qin, L., & Li, J. S. (2023). Efficacy of laparoscopic inguinal hernia in day surgery mode and inpatient surgery mode in China: A meta-analysis. *Medicine*, 102(8), e32998.

APPENDICES

APPENDIX I: DATA COLLECTION TOOL

Study title: Incidence and factors associated with early complications following ambulatory inguinal hernia surgeries at Mulago National Referral Hospital: A prospective cohort study.

Study number

patient number

Part I: Socio-demographics

1. Age (years)

2. Sex (Tick appropriate)

a) Male ☐

b) Female ☐

2. Smoking status

a) Current smoker ☐

b) Previous smoker ☐

c) Non-smoker ☐

Part B: Pre-existing medical conditions (Tick appropriate).

1. Diabetes mellitus ☐

2. Hypertension ☐

3. Cardiovascular disease (specify)

4. ASA grade ☐

Part C: Procedure-related parameters. 1.

Hernia type/size (tick appropriately)

a) inguinal ☐

b) inguino-scrotal ☐

2. Hernia repair technique (tick appropriately)

- a) Tissue repair ☐
- b) Mesh repair ☐
3. If tissue repair technique, specify (e.g., Basini repair)

2. Anesthetic technique used (Tick appropriately)

- a) Local anesthetic infiltration ☐
- b) Regional anesthesia (specify)
- c) Local anesthetic plus sedation ☐

3. Cadre of primary surgeon (Tick)

- a) Junior house officer (Intern) ☐
- b) Senior House officer (SHO) ☐
- c) Consultant ☐

3. Duration of surgery (in hours)

Part: Outcome

1. Early complications (Tick appropriate)

- a) None ☐
- b) Major cardiovascular event ☐
- c) Urinary retention ☐
- d) Bleeding/ hematoma formation ☐
- e) Postoperative Nausea and Vomiting ☐
- f) Surgical site infection ☐

2. Pain score (VAS score) (record score for each)

- a) Immediate post-operative period
- b) 7th post-operative day

3. Unplanned hospitalization at any health unit within 7 days of the postoperative period (tick appropriately)

a) Yes

☐

b) No

☐

3. If yes above, state the reason for
hospitalization

4. Level of satisfaction with the ambulatory surgery;

(On a scale of 1-10; 1 being unsatisfied, 10 being very satisfied)

APPENDIX II: VISUAL ANALOGUE SCALE (VAS) SCORING SHEET.

Visual Analogue Scale (VAS) for pain¹

Name: _____ Date: _____

Place a mark on the line below to indicate your current level of pain².

0 10

No pain Pain as bad as it could possibly be

Please ensure you print this document to scale so that the VAS line is 10cm long.

APPENDIX III: BUDGET

ACTIVITY	Item	Quantity	Unit cost (Ug. Shs)	Total cost (Ug. Shs)
Proposal development	Printing	35 pages,5 copies	100	17500
Proposal presentation to department and IRB	Printing	35 pages, 2 copies	100	7000
Proposal minutes	Printing	2 pages, 2 copies	100	
DATA COLLECTION TOOL				
Questionnaires	Printing	140 copies	500	70000
STATIONARY				
Binders		20 copies	3000	60000
Folders		10	2000	20000
Data collectors/records personnel		2	1000000	2000000
statistics	Statistician	1	2000000	2000000
Data	Data entry	1	1500000	1500000
Data analysis and reporting	External hard disk	1	500000	500000
Miscellaneous			1000000	1000000
Total				5824900

APPENDIX IV: WORKPLAN

Activity	March 2024 to April 2024	April 2024 to August 2024	August 2025	September 2025 onwards
Proposal development				
Proposal approval				
Data collection				
Data analysis				
Report writing				
Report Submission				
Dissemination of study results				