WOLKITE UNIVERSITY

COLLEGE OF MEDICINE AND HEALTH SCIENCES

DEPARTMENT OF SURGERY

POOR OUTCOMES OF ILEOSIGMOID KNOTTING AND ASSOCIATED FACTORS AMONG ADULT PATIENTS OPERATED AT WOLKITE UNIVERSITY COMPREHENSIVE SPECIALIZED HOSPITAL: A CROSS-SECTIONAL STUDY (JANUARY1, 2020 – DECEMBER 31, 2025)

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Title of the Research	**Poor Outcomes and Associated Factors of Ileosigmoid Knotting Among Adult Patients Operated at Wolkite University Comprehensive Specialized Hospital: A Six-Year (January1, 2020 –December 31, 2025)**
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APPROVAL SHEET

We hereby certify that we have read and evaluated this Thesis titled "Poor Outcomes of Ileosigmoid Knotting and Associated Factors Among Adult Patients Operated at Wolkite University Comprehensive Specialized Hospital: A Cross-Sectional study (January1, 2020 – December 31, 2025)" prepared under our guidance by Dr Sintayehu Bekele. We recommend that the Thesis shall be submitted as fulfilling the requirements for the award of Specialty Certificate in General Surgery. It has been submitted for examination with our approval as university advisors.

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As members of board of examiners of the specialization in general surgery thesis open defense examination, we have read and evaluated this thesis prepared by Dr Sintayehu Bekele and examined the candidate. We hereby certify that; the thesis is accepted for fulfilling the requirements for the award of Specialty Certificate in General Surgery.

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DECLARATION

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ABBREVIATIONS

ASA = American Society of Anesthesiologists

ETB = Ethiopian Birr

Hrs. = Hours

ISK = Ileosigmoid knotting

JUMC = Jimma University Medical Center

Post-Op = Post Operative

R4 = year 4 Resident

SPHMMC = St. Paul's Hospital Millennium Medical College

SSI = Surgical site infection

WUCSH = Wolkite University Comprehensive Specialized Hospital

COR= Crude Odds Ratio

AOR= Adjusted Odds Ratio

C.I.= Confidence Interval

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ABSTRACT

Introduction

Ileosigmoid knotting (ISK) is a rare but unique life-threatening surgical emergency in which a loop of the ileum and the sigmoid colon wrap around each other. The aim of this study was to evaluate poor outcomes and associated factors among adult patients operated for ISK.

Methods

This is institution-based cross-sectional study conducted at Wolkite University Comprehensive Specialized Hospital in Wolkite, Central Ethiopia. The study reviewed medical records over a six-year period, from January 1, 2020, to December 31, 2025, and included 54 adult patients who underwent surgery for ileosigmoid knotting. Secondary data were extracted from patient medical records and analyzed using SPSS version 27. A p-value of <0.05 was considered statistically significant.

Results

Of the 54 patients, 50 (92.5%) had complete medical records and were included in the analysis. Poor postoperative outcomes occurred in 23 patients, giving a proportion of 46% (95% CI: 31.8%–60.7%). Age (AOR=2.05, 95% CI: 1.03–4.07), bowel gangrene (AOR=3.84, 95% CI: 1.46–10.10), preoperative shock (AOR=4.34, 95% CI: 1.48–12.69), and prolonged duration of symptoms (AOR=11.03, 95% CI: 2.69–45.20) were independently associated with poor postoperative outcome.

Conclusions and recommendations

Nearly half of the participants had poor postoperative outcome. It is associated with advance age, delayed presentation, preoperative shock, and presence of bowel gangrene. Early recognition, prompt surgical intervention, and aggressive perioperative optimization, and stoma creation in double bowel gangrene are essential to improve outcomes.

1. INTRODUCTION

1.1. Background of the study

A loop of ileum wrapping around the base of a redundant sigmoid colon (or vice versa) induce ileo-sigmoid knotting (ISK) [1,2]. Although ISK is a rare cause of intestinal obstruction in the West, it is a known cause in regions of Africa, Asia, and the Middle East where sigmoid volvulus is highly prevalent [1,2].

The main anatomic abnormalities that predispose to ISK are a lengthy small bowel mesentery, a freely mobile small bowel, and a redundant sigmoid colon on a narrow mesenteric base. ISK may also be caused by additional conditions such eating a high-bulk diet while the small intestine is empty, late pregnancy, surgical adhesions, malrotation, internal herniation, and Meckel's diverticulum [1,2,4].

Most cases of ISK are diagnosed intra-operatively due to the rarity of this condition and nonspecific clinical, laboratory, and X-ray features [2,4,5]. Abdominal pain, abdominal distention, failure to pass feces and/or flatus, and vomiting are the major complaints. Signs of bowel compromise occur early due to the double closed-loop nature of the obstruction [6-10]. A triad of a clinical picture of small bowel obstruction, radiographic features of large bowel obstruction, and inability to insert an endoscope has been proposed as a useful diagnostic triad of ISK [6,11,12].

Adequate resuscitation followed by emergency laparotomy is the standard of care for patients with ISK. The type of procedure depends on the presence or absence of bowel gangrene and patient's condition. It can range from detorsion alone for viable bowel to resection of a significant portion of the bowel for gangrenous bowel. But most of the ISK cases had gangrenous bowel. Even though a variety of procedures are performed to manage strangulation in ISK, the preferred is resection of gangrenous segments with primary anastomosis of the ilium and sigmoid end colostomy. In addition, stomas (colostomy or ileostomy) after resection can be performed as a damage control procedure in patients with poor general condition or with bowel problems such as edema and size discrepancy between proximal and distal bowel diameters [2,5-7].

High rates of gangrene in the ileum, sigmoid colon, and occasionally even the caecum and ascending colon are consequences of ISK [1,2]. Due to this aggressive nature of the disease, it carries high morbidity and mortality. Factors such as advanced age, late presentations and diagnosis, presence of comorbidities, and pregnancy are associated with increased mortality [2,4,6,8,10,12].

1.2. Statement of the Problem

The incidence of ISK is not well established, but according to Atamanalp SS.et.al its incidence is 1.6 cases per year and 0.4 cases per 100,000 persons per year [5]. Studies conducted on large bowel obstructions have reported a higher incidence in regions having high rates of sigmoid volvulus, with ISK accounting for 8.8% of sigmoid volvulus cases and 1.7% of all mechanical obstruction cases. and in countries along the sigmoid belt [2,12]. Ileosigmoid knotting is more commonly reported in certain parts of Africa, including Ethiopia, Asia, and the Middle East [4,5,15,12].

Globally, despite developed surgery and modern perioperative care techniques, the prognosis of ISK has not demonstrated any statistical difference over the last half-century. The mortality rate varies between 0-48% and the morbidity rates are 30-80%, with the most common complications being wound infection/dehiscence, anastomosis or stoma problems, pulmonary, cardiovascular, renal, gastrointestinal complications, and adhesive ileus [4].

The burden of ISK is significant in Africa, especially in Sub-Saharan Africa, due to resource scarcity and limited use of diagnostic imaging. In a review of 61 cases in Kenya, morbidities noted in 24.6% patients, including surgical site infection in 13.1%, respiratory failure in 6.6%, fascial dehiscence in 4.9%, enterocutaneous fistula in 3.2%, and renal failure in 1.6% of cases. At discharge, mortalities occurred in 11.5% of patients [2]. A 7-year retrospective analysis at Parirenyatwa Group of Hospitals, Zimbabwe, respiratory complications were noted in 28.6%, and Anastomotic leak occurred in 4.8%. Mortality rate was relatively low (4.8%)**,** which was attributed to factors such as early presentation, mandatory ICU care, and improved perioperative management [15].

In Ethiopia, particularly in rural and resource-limited settings, delays in presentation, lack of advanced diagnostic modalities, and inconsistent surgical management contribute to a high burden of morbidity and mortality associated with ISK. In studies, pre-operative diagnosis accuracy ranges from 0 – 32.4%, the post-Op Complication Rate ranges from 39.3% - 60%, and the Mortality Rate ranges from 7.9% - 66.6%, which are higher when compared to other African studies [6,10,16,17].

Despite its prevalence and severity, there is limited comprehensive local data on the surgical outcomes of ISK and the factors that influence these outcomes. Due to these, it is difficult to develop effective surgical protocols, allocate resources, or improve clinical outcomes. At Wolkite University Comprehensive Specialized Hospital (WUCSH), emergency laparotomies for intestinal obstruction are frequently performed, and ISK is encountered with notable clinical challenges.

This study, therefore, seeks to fill this gap by evaluating the poor outcomes and identifying associated factors with in adult patients operated for ISK at Wolkite University Comprehensive Specialized Hospital over six years.

1.3. Objectives

1.3.1. General Objective

To determine poor outcomes and associated factors among adult patients operated for ileosigmoid knotting at Wolkite University Comprehensive Specialized Hospital from January 1, 2020 to December 31, 2025.

1.3.2. Specific Objectives

1. To assess poor postoperative outcomes of adult patients operated for ISK at Wolkite University Comprehensive Specialized Hospital.
2. To identify the associated factors of poor outcomes of ISK operation at Wolkite University Comprehensive Specialized Hospital.

1.4. Significance of the study

Ileosigmoid knotting (ISK), which is a rare but life-threatening cause of acute intestinal obstruction, is associated with rapid progression to bowel ischemia, gangrene, sepsis, and high mortality if not promptly managed. Although it is more prevalent and associated with a significant health burden, there is limited institution-specific data in Ethiopia, particularly in the catchment area served by Wolkite University Comprehensive Specialized Hospital. Therefore, the findings of this study will help guide better clinical decisions, improve early recognition and management strategies, and reduce morbidity and mortality related to this complex condition.

Additionally, this study will be used as a baseline study or data for further researchers.

1.5. Justification for the Current Study

Although several studies have been conducted in different parts of Ethiopia and other low-income countries, data from central Ethiopia, particularly Wolkite and surrounding zones, are scarce. Most existing studies are hospital-based case series or focus on general intestinal obstruction without disaggregated analysis of ISK cases.

There is also limited research on the pattern of surgical procedures, long-term outcomes, and institution-specific factors that may affect prognosis, such as surgical expertise, availability of ICU care, or referral delays.

Given the lack of data in this specific region and the high morbidity associated with ISK, a focused evaluation of outcomes and associated factors at Wolkite University Comprehensive Specialized Hospital is timely and relevant. This study will help:

- ✓ Identify modifiable factors of poor outcomes
- ✓ Describe surgical management practices
- ✓ Contribute to national and institutional strategies for improving surgical care

1.6. Operational Definitions

- ✓ **Time to Presentation**: The duration from the onset of symptoms to hospital presentation
- ✓ **Adult Patient**: Any individual aged 15 years or older at the time of surgery.
- ✓ **Operated Case**: A patient who underwent emergency exploratory laparotomy and had an intraoperative diagnosis of ISK.
- ✓ **Intraoperative Findings**: Surgical observations recorded in the operative notes, including: Type of ISK (Type I, II, III, or IV), presence or absence of bowel gangrene, affected bowel segment, presence of peritoneal contamination
- ✓ **Surgical procedure performed**: the definitive operation carried out during laparotomy such as: Resection and primary anastomosis, Resection with stoma formation, or Simple untwisting.
- ✓ **Prolonged length of surgery:** Total duration of procedure >3 hours during laparotomy.
- ✓ **Postoperative Complications**: Any unfavorable outcome occurring post-surgery, including: surgical site infection (SSI), anastomotic leak, pneumonia, ileus, wound dehiscence, and death.
- ✓ **Peritoneal contamination:** presence of bowel perforation, hemorrhagic fluid or pus in the general peritoneum at the time of laparotomy.
- ✓ **Length of hospital stay**: number of days that the patient stayed from admission to discharge.
- ✓ **Prolonged Hospital Stay**: A postoperative hospital stay longer than 7 days from the date of surgery time documented in patient charts.
- ✓ **Delayed Presentation**: A presentation to the hospital ≥24 hours after symptom onset.
- ✓ **Complete Medical Record**: A patient chart that contains all required variables for the study: demographic data, preoperative patient condition, intraoperative findings, surgical intervention, and outcome data.
- ✓ **Anastomotic leak**: presence of a fecal fistula or anastomotic failure seen at re-laparotomy.

- ✓ **Anemia**: a HGB level of <11 g/dl.
- ✓ **Surgical site infections**: an infection that occurs within 30 days of the index operation.
- ✓ **Mortality**: In-hospital death from any cause after surgery for ISK during the same admission.
- ✓ **Dependent (Outcome) Variable**
  - **Good outcome**:
    - The patient survives without major postoperative complications and is discharged in improved condition.
  - **Poor outcome:**
    - Defined as the presence of any of the following after surgery for ISK:
      In-hospital mortality (death during admission/postoperative period).
      Postoperative complications (such as: Anastomotic leak, Wound dehiscence, Surgical site infection, Hospital Acquired pneumonia, Ileus…)

In this study, coding for analysis:

Good outcome = 0

Poor outcome = 1

2. LITERATURE REVIEW

2.1. Global, African, And Ethiopian Perspectives

Global Perspectives

Ileosigmoid knotting is a surgical emergency in which the ileum makes a knot with the sigmoid colon (or vice versa), causing a closed-loop intestinal obstruction and bowel necrosis (8,14). Ileosigmoid knotting was first reported by Parker in 1845, and the first patient in Africa was reported by Burkitt in 1952 who described 6 cases of '' double volvulus'' in Uganda [13]. Later, Shepherd introduced the term "Ileosigmoid knotting" in 1967 to describe a particular ailment [23,24]. The incidence of ISK is not well established, but according to Atamanalp SS.et.al, its incidence is 1.6 cases per year and 0.4 cases per 100,000 persons per year [5].

Since ileosigmoid knotting has been identified as a clinical entity, it has been described as case reports and case series. But in the last decade, there are many case reviews, and few multi-center studies.

A review of 68 cases conducted in Turkey indicated that the majority of patients were in the third and fourth decades of life, with a mean age of 36.2 years, age ranging from 10 to 80 years. in this review, there is marked male predominance with male to female ratio 8:1 [7]. Similar findings reported from a review of 280 cases as ISK predominately seen in males (80.2%) with a mean age of 40 years (range, 4-90 years) [8]. Additionally, ISK is predominately reported in certain African, Asian, and Middle-East nations, it is a rare occurrence in the white population [2,4,7,8].

In one of the largest single-center ISK series in the world, Atamanalp et al. presented clinical experience with 80 patients treated over a 51.5-year period and showed the incidence of ISK was 1.6 cases per year and 0.4 cases per 100,000 persons per year. The mean age was 47.5 years (range: 7-92 years). Of the patients, 58 (72.5%) were male [5].

According the largest multicenter ISK series over the world conducted in 2022 comprising 923 cases, the maximum patient number was reported from Turkey (213 patients, 25.4%),

while the following countries were noted as Uganda 118, Malawi 99, Finland 73, Kenya 61, Ethiopia 60, India 44, Tanzania 24, Zimbabwe 23, South Africa and Ivory Coast 16, Canada 15, Nigeria 12, Iran 11, England and Morocco 8, Japan 6, United States 5, Russia and Pakistan 4, France and Ghana 3, Spain and Rhodesia 2, Australia, Scotland, Korea, Oman, Greece, Holland, Botswana, Sri Lanka and Kuwait each 1. Among evaluated patients, the mean age was 43.9 years (range: two weeks-92 years), and the male/female ratio was 4:1 [4].

African Perspectives

The earliest and the largest African series of its time, describing 92 cases of ISK in 1967, showed the highest incidence in the group aged 30-39 years with an average age of 42 [3]. In a seven-year retrospective chart review of patients managed for ISK at Tenwek Hospital in Bomet, Kenya, total of 61 cases were identified, with 51 (83.6%) males and 10 (16.4%) females, and had a mean age of 35.8 years (range 2-68). Peak incidence of ISK was noted in the 31-40 years age group, and the majority of cases (70.5%) were between 11-50 years of age [2]

Although uncommon globally, ISK has a higher incidence in Sub-Saharan Africa, particularly in regions with high prevalence of sigmoid volvulus, such as Ethiopia, Kenya, Nigeria, and Uganda [4,8]. Studies in these areas stated that the contributing factors are anatomic predispositions, like a long, mobile small bowel mesentery and a redundant sigmoid colon with a narrow mesenteric base. Similarly, dietary factors, such as a single bulky meal in the presence of an empty bowel stated as a contributing factor [4,7,8]

Due to the rarity of ISK, few large-scale studies exist, with most evidence from small case series or single-center reviews. More multicenter studies are needed to understand regional variations in the Sub-Saharan region, and Africa as a whole.

Ethiopian Perspectives

Ethiopia, a part of the "volvulus belt" that covers parts of Africa and Asia, has a relatively higher incidence of ISK compared to Western nations [4]. Several retrospective studies have been conducted in tertiary hospitals such as Black lion hospital (Tikur Anbessa Specialized

Hospital), St. Paul's Hospital Millennium Medical College (SPHMMC), Bahir Dar, Jimma, Hawassa and in some general hospitals [6,10,16,17].

Despite its prevalence and clinical significance, no national registry or multicenter database is tracking ISK, which limits comparative and outcome-based research.

2.2. Clinical Presentations of ISK

In one of the largest single-center series in the world, evaluating and analyzing the clinical experience of patients treated over a 51.5-year period (retrospective until June 1986 and prospective until January 2018), found that the incidence of ISK was 1.6 cases per year and 0.4 cases per 100,000 persons per year. The mean age was 47.5 years (range: 7-92 years). Of the patients, the male-female ratio was 2.6:1 [5]. A similar report was found in a literature review of 280 patients, as ISK is predominantly seen in males (80.2%) with a mean age of 40 years (range, 4-90 years). 95.7% were over the age of 16 years. While ISK is predominantly reported in certain African, Asian, and Middle Eastern nations, it is a rare occurrence in the white population [8].

In an African study reviewing 61 patients with ISK reported 51 (83.6%) were males and 10 (16.4%) females, and had a mean age of 35.8 years (range 2-68). Peak incidence of ISK was noted in the 31-40 years age group, and the majority of cases (70.5%) were between 11-50 years of age. Mean duration of presentation was 1.6 days (range 3 hours-7 days) after symptom onset, with the majority (39, 63.9%) presenting within 1 day or less [2]. In another retrospective analysis of 21 patients, the median age was 37 years (range 18–65 years) with a 6:1 male to female ratio. The median duration of symptoms at presentation was 12.5 hours (range 2–39 hours) [15].

In a review of medical records of 28 patients at St Paul Hospital, Males were commonly affected with a male-to-female ratio of 3:1. The peak age was between 20 and 29 years, with the mean age of the patients being 41.7 years (SD±19.5), and ranged from 18 to 80 years. The average duration of illness was 1.6 days (SD±1.1), and 89.3% presented within 48 hours. 75% of patients who reside in rural areas presented later than 24 hours, while 87.5% of patients from urban settings presented within 24 hours [6]. In another institution-based six-year cross-

sectional study conducted at Debre Markos Comprehensive Specialized Hospital, reviewing 38 patient charts who underwent emergency laparotomy for an ISK, the majority were males (M: F 3.2:1), and the mean age of the patients was 39.2 years (SD ± 10.2). Of these 38, 78.9% patients presented within the first day of symptom onset, and the mean duration of symptoms was 1.39 (SD ± 0.85) days [17].

Clinical presentations of ISK are dramatic, which is evidenced by a short time interval between the onset of symptoms and the time to seek medical attention [4,6,16,17]. In one of the largest world review of 923 cases of ISK, the mean symptom period was 48.1 hours (range: 2 hours-16 days). The most common clinical features were abdominal pain/tenderness in 99.1%, distention in 88.3%, obstipation/constipation in 58.8%, and vomiting in 55.5%, while the other findings were rebound tenderness and/or muscular rigidity in 32.1%, hypo/a-kinetic bowel sound in 81 14.0%, hyperkinetic bowel sound in 5.9%, melanotic stool in 2.9%, fever in 2.8%, and 28.8% were in shock state [4].

Another study analyzing the clinical experience of patients treated over a 51.5-year period revealed clinical presentation of ISK with Abdominal pain (100.0%), obstipation (98.8%), distention (96.3%), and vomiting (77.5%) as the most common symptoms. Abdominal tenderness (100.0%), distention (96.3%), hypo/akinetic bowel sounds (62.5%), empty rectum (50.0%), guarding/rebound tenderness (47.5%), hyperkinetic bowel sounds (27.5%), and melanotic stool (15.0%) were the most common physical findings. Of the patients, 53.8% were in a shock state [5].

In a study done at JUMC, 75% of the patients with ISK presented with abdominal pain. Of the total patients with ISK, 40% of them had shock before surgery, of which 4 patients responded to fluid-only resuscitation, while the rest needed vasopressor. The average pulse rate at presentation was 113.48 (SD ±15.364) and ranged from 80 to 140. According to the intraoperative finding, 52.5% of the patients had both gangrenous ileum and sigmoid colon; however, 85% of the patients had either gangrenous ileum, sigmoid, or both. Of the total patients, 45% had organ dysfunction and 35% were admitted to the ICU [16].

In another retrospective analysis conducted at SPHMMC, abdominal pain and vomiting were seen in all patients, followed by abdominal distention (85.7%) and failure to pass feces or

flatus (82.1%). 92.8% had gangrenous bowel. The commonest procedure performed was gangrenous segments with primary ileoileal anastomosis and sigmoid end colostomy 57.1% [6]. In another institution-based cross-sectional study conducted at Debre Markos Comprehensive Specialized Hospital, the most commonly performed procedure (68.4%) was resection of both segments with primary ileo-ileal and colorectal anastomosis [17].

In seven year retrospective chart review of patients managed for ISK at Tenwek Hospital in Bomet, Kenya, gangrene was noted to involve both the ileum and colon in 73.8% of patients, the ileum only in 14.7% of patients, and the sigmoid colon only in 1.6%. Resection and primary anastomosis was carried out in most cases of gangrenous ileum (89%) and gangrenous sigmoid colon (74%), while resection and stoma was performed in 13% patients with gangrenous colon [2]. In another African retrospective analysis, all patients had gangrenous small bowel, with 81% having a gangrenous sigmoid colon. All cases underwent small bowel resection and primary anastomosis plus Hartmann's procedure [15].

According to Alver et al. in 1993, ISK is classified into four types based on the mechanism of formation of the knot. In type I, the ileum is the active component, wrapping itself around the sigmoid colon (passive component) to form the knot. It is the commonest type. Type II is when the sigmoid colon (active component) wraps itself around the ileum. In type III, the ileo-cecal segment acts as the active component, while in type IV (undetermined type); it is not possible to differentiate the two components from each other. Type I and II can be further classified into subtypes A and B, depending on whether the torsion is clockwise or counterclockwise, respectively [7]. ISK type I accounts for 53.9%–83.2% of all documented cases. Type II accounts for 16.8%–20.6% and type III accounts for 1.5%, and other types remain undetermined. In 60.9%–63.2% of cases, the direction of torsion is clockwise [4,7-9].

2.3. Outcomes of ISK Management, And Associated Determinants of Outcome

A seven year (2008 - 2014) retrospective chart review of 61 patients managed for ISK at Tenwek Hospital in Bomet, Kenya showed a complication rate of 36.1%. Morbidities were noted in 24.6% of patients, including surgical site infection (SSI) (13.1%), respiratory

insufficiency (6.6%), fascial dehiscence (4.9%), anastomotic leak (3.2%), and renal failure (1.6%). Death occurred in 11.5% of patients. The mean duration of hospitalization was 8.3 days. Older age (>60 years), presence of gangrenous bowel, and delayed presentation were factors related to higher mortality [2].

Outcome of ISK has a poor prognosis due to the presence of early gangrene and sepsis, resulting in mortality of 48% which can reach 100% [4,7,18]. The incidence of mortality is related to advanced age, comorbidities, duration of symptoms, presence of gangrene and septic shock, leading to multiorgan failure [18]. In a retrospective medical record review of 25 patients operated for ISK in the University of Gondor between 2018 and 2023, complications were seen in 64% patients. The commonest postoperative complications seen were pneumonia in 16%, wound dehiscence in 12%, anastomotic leak in 12%, urinary tract infection in 8%, SSI in 4%, and death occurred 4% of patients. The average duration of hospitalization was 8.28 days (SD ±3.4) and ranged from 5 to 21 days. Shock at admission, pregnancy/postpartum state, delay in presentation, primary anastomosis in unstable/septic patients were associated with poor outcomes. Diversion stomas, ICU support, antibiotics, and adequate resuscitation are associated with few complications, and improved survival [1]. Similarly high rate of complications seen in another study with postoperative complications occurring in 52.6% of patients, the most common being anemia (31.6%), hospital-acquired pneumonia (23.9%), SSI (21.1%), and anastomotic leak (15.8%). Mortality occurred in 7.9%, and was significantly associated with anastomotic leaks and double anastomosis. But, shock at presentation, pre-op anemia, and symptom duration (<24 h vs ≥24 h) showed no significant association with complications or mortality. The average hospital stay was 8.2 days [17].

A retrospective study conducted at SPHMMC from 2014 to 2020 showed a complication rate 39.3% of patients. The commonest postoperative complication was SSI (25%). Four patients had deep SSI, which required relaparotomy. Acute renal failure (ARF) was noted in 7.2% patients who had shock either at presentation or intraoperatively. Generally, the risk of complication was similar between patients who had double (41.2%) and single (44.4%) segment gangrene. But anastomotic leak was entirely seen in patients with double-segment strangulation (17.6%). New-onset intraoperative shock was documented in 14.3% patients. The average duration of hospitalization was 10.7days and ranged from 2 to 40 days. Death

occurred in 21.4% of patients. Multiorgan failure due to sepsis was the cause in all cases. All the mortalities occurred in patients with gangrenous bowel, either double segment (23.5%) or single segment (22.2%). Age, sex, residence, duration of presentation, intraoperative finding, intraoperative time, and anastomotic leak had no statistically significant association with mortality. But patients with intraoperative shock had a higher chance of death than patients without intraoperative shock [6].

Another study conducted at JUMC, a cohort of 40 patients followed for 347 person-days, showed a death of 27.5% of patients treated for ISK. SSI is the most common postoperative complication (50%), followed by organ dysfunction of 44.4%. The overall incidence of death was 3.2 per 100 person-days [16]. In this study, as opposed to SPHMMC study, age, shock at presentation, comorbidities, pulse rate intraoperatively, and postoperative pulse rate were found to be statistically significant predictors of time to death [6,16].

Higher mortality and morbidity rates are associated with delayed presentation to hospital (>24hrs), bowel gangrene, hemodynamic instability, and sepsis or peritonitis on arrival [9,12,14,19,20]. Additionally, several studies have attempted to identify predictors of poor prognosis in ISK as advanced age, delay in presentation and intervention, preoperative shock, gangrenous bowel, high American Society of Anesthesiologists (ASA) score, and extensive bowel resections [10,19,21]. But a retrospective study at Jimma University Medical Center found no statistically significant association between the duration of symptoms and the degree/status of bowel strangulation and found age, pre- and postoperative tachycardia, shock at presentation, and comorbidity are significant predictors of mortality (all p-value <0.05) [16].

CONCEPTUAL FRAMEWORK: POOR OUTCOMES OF ISK MANAGEMENT, AND ASSOCIATED DETERMINANTS OF POOR OUTCOME

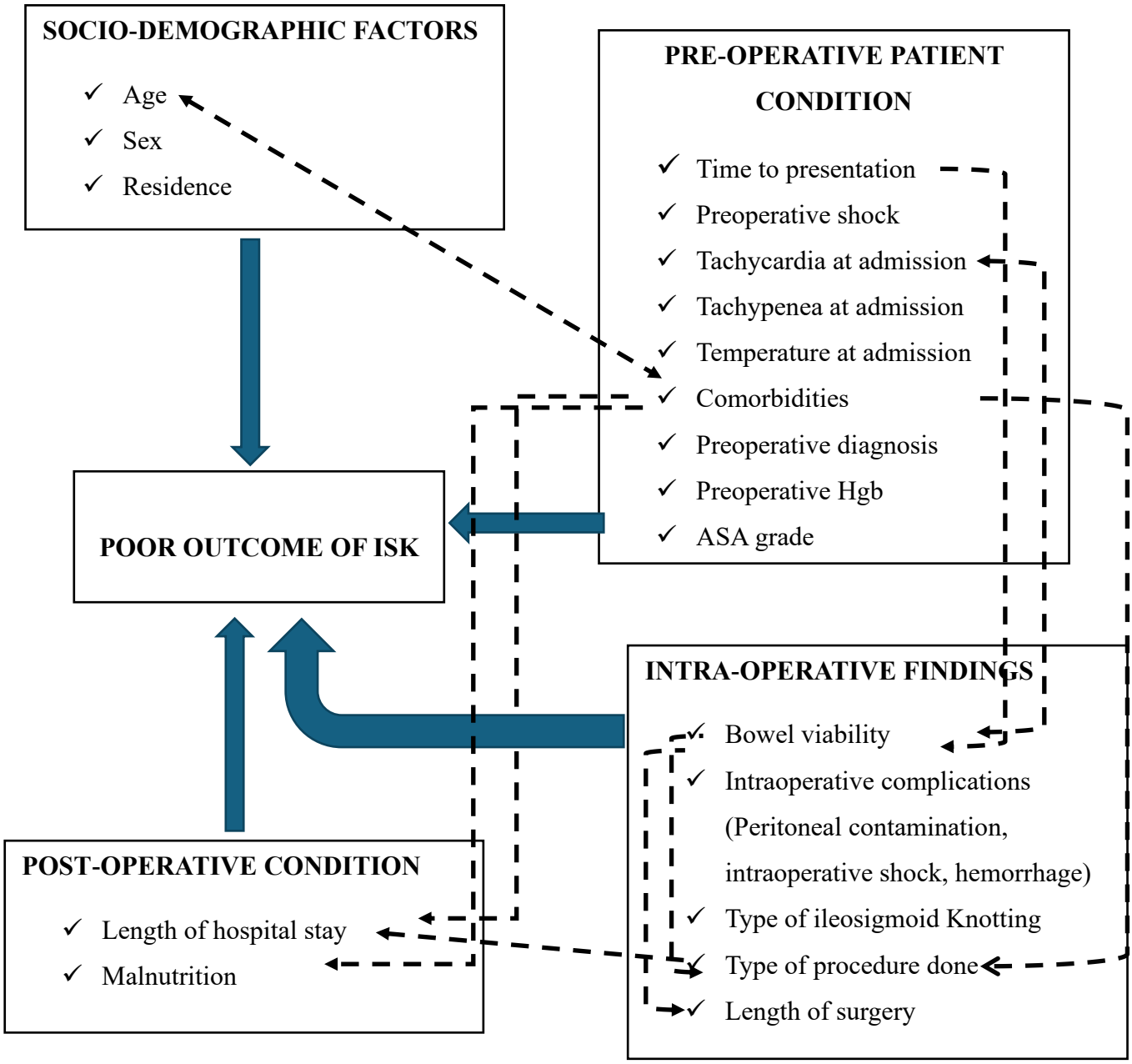

Figure 1: *Conceptual Framework*

3. METHODS AND MATERIALS

3.1. Study Area

Wolkite University Comprehensive Specialized Hospital (WUCSH) is found in Central region of Ethiopia. The teaching hospital is located in Wolkite town of Gurage Zone located at 158 km south to the capital city, Addis Ababa. WUCSH was established in 2019 and provides services for a catchment population of over 4 million people. It has a total capacity of 220 inpatient beds in four major departments and other units with a total of 115 physicians, 240 non-physician health professionals, and 156 supportive and technical staff.

3.2. Study Design and Period

This was a hospital-based cross-sectional study reviewing secondary data from medical records of adult ileosigmoid knotting patients operated at Wolkite University Comprehensive Specialized Hospital between January 1, 2020, to December 31, 2025.

The study was conducted from July to December 31, 2025.

3.3. Source and Study Population

- ✓ Source Population: All adult patients who had been operated for Ileosigmoid knotting in WUCSH was the source population.
- ✓ Study Population: All adult patients with Ileosigmoid knotting who had been operated at WUCSH from January 1, 2020, to December 31, 2025.

3.4. Inclusion and Exclusion Criteria

3.4.1. Inclusion Criteria

- ✓ Adult patients (age ≥15 years) diagnosed and operated for ISK at WUCSH from January 1, 2020, to December 31, 2025.

3.4.2. Exclusion Criteria:

- ✓ Patients with incomplete record were excluded from the study

3.5. Sample Size and Sampling Procedures

Because of the limited number of cases, a Consecutive sampling of all 54 adult patients operated for ISK and fulfilling eligibility criteria at WUCSH from January 1, 2020, to December 31, 2025, was reviewed.

3.6. Variables of the Study

3.6.1. Dependent Variables:

Poor outcomes of operated ISK

3.6.2. Independent Variables

Socio-demographic characteristics: Age, Sex and residence

Pre-operative patient condition: Time to presentation, Preoperative shock, Tachycardia at admission, Tachypenea at admission, Temperature at admission, Comorbidities, Preoperative diagnosis, Preoperative Hgb,

Intraoperative findings: Bowel viability, Intraoperative complications (Peritoneal contamination, intraoperative shock, hemorrhage), Type of ileosigmoid Knotting, Type of procedure done, Length of surgery

Post-operative factor: length of hospital stay, malnutrition

3.7. Data Collection Procedures

Data was collected by trained personnel using a structured data extraction form. Sources used are operative registers, patient charts, and discharge summaries. Key information abstracted are demographic data, preoperative patient condition, intraoperative findings, and postoperative course.

3.8. Date Quality Assurance

All data collected using a structured data extraction form. Data collectors underwent a training before data collection on research ethics, confidentiality, tool usage, and data entry procedures to ensure consistent understanding and application. The data extraction form was prepared in English, and a pre-test was conducted on 5% of the patients from Butajira General Hospital before the actual data collection to check its relevance for the extraction of appropriate data. The completeness and consistency of the data checked on a daily basis during the data collection period.

3.9. Data processing and Analysis

Data were cleaned, edited, coded, and entered into EpiData Manager, then exported to SPSS for analysis. Descriptive statistics, including frequencies and percentages for categorical variables (such as poor outcome), and means (±SD) or medians (IQR) for continuous variables, were computed.

Associations between independent variables and outcome variable was assessed. Variables with $p<0.2$ in bivariate analysis were candidates for multivariate binary Logistic Regression. Statistical significance was set at $p<0.05$. Findings are presented in tables.

4. ETHICAL CONSIDERATIONS

Ethical approval was sought from the Institutional Review Board (IRB) of Wolkite University. Permission to access patient records and consent was taken from hospital administration. Confidentiality strictly maintained. No personal identifiers were recorded. All data was stored securely and used only for this study. Findings shared in aggregate form, without revealing individual patient identities.

5. DISSEMINATION OF RESULTS

The findings of this study will be formally presented to the Wolkite University Department of Surgery and discussed during hospital clinical audit meetings to facilitate academic review and quality improvement initiatives. In addition, the results will be prepared and submitted to appropriate local and national peer-reviewed journals for publication to ensure wider scientific visibility. Furthermore, the study will be presented at national surgical conferences to promote professional discourse, knowledge translation, and potential integration into clinical practice guidelines.

6. RESULTS

Socio-demographic characteristics of the patients

From a total of 54 patient who underwent operation for ISK during the study period, medical records of 50 patients were reviewed, and analyzed**.** Males were affected more than females accounting for 94% (OR: 1.76 (95% C.I. 0.149-20.763)) of cases. The peak age for ISK was in patients ≥60yrs, the occurrence ranging from 22 to 85years. **Table 1.**

Table 1: Socio-demographic characteristics of patients operated for ISK at WUCSH, Wolkite, Ethiopia, from January 2020 to December 2025.

Variables	**Categories**	**Frequency (n=50)**	**Percentage**
Sex	Male	47	94.0
	Female	3	6.0
Age	20–29	2	4.0
	30 - 39	3	6.0
	40 - 49	9	18.0
	50 - 59	15	30.0
	≥60	21	42.0
Residence	Urban	16	32.0
	Rural	34	68.0

Pre-operative Condition of the Patients

Patients who presented within the 24hrs of onset of symptom accounted for 40% (n=20). Twelve percent of patients had comorbidity which are hypertension and cardiovascular diseases, while one patient was in her third trimester pregnancy. More than half (27, 54%) had tachycardic, and 10(20%) were in shock at presentation. Diagnosis of ISK made preoperatively in only three (6%) patients, and the majority (33, 66%) diagnosed to have small bowel obstruction. (**Table** 2)

Table 2: pre-operative condition of patients operated for ISK at WUCSH, Wolkite, Ethiopia, from January 2020 to December 2025.

Variables	**Categories**	**N**	**(%)**
Duration of symptoms	< 24 hours	20	40.0
	24 to 48 hours	18	36.0
	> 48 hours	12	24.0
Preoperative shock	Yes	10	20.0
	No	40	80.0
Tachycardia at admission	No	23	46.0
	Yes	27	54.0
Temperature at admission	< 36.5	6	12.0
	36.5 - 37.4	42	84.0
	≥37.5	2	4.0
Tachypenea at admission	No	35	70.0
	Yes	15	30.0
Preoperative Hgb in g/dl	7.1 - 10.0	2	4.0
	10.1 - 12.9	19	38.0
	≥13	29	58.0
Preoperative diagnosis	Ileosigmoid knotting suspected	3	6.0
	Small bowel obstruction	33	66.0
	Large bowel obstruction	5	10.0

	Mixed small and large bowel obstruction	6	12.0
	Mesenteric ischemia	3	6.0
Comorbidity	Hypertension	3	6.0
	Cardiovascular disease	3	6.0
	None	44	88.0
ASA grade	Grade I	46	92.0
	Grade II	4	8.0

Intraoperative findings

In 29 (58%) of patients, an active component of the obstruction knot was the ileum, and the sigmoid colon was an active component in 21(42%) of patients. Double ileum and sigmoid colon gangrene observed in 52% (n=26) of the patients. Resection of both ileum and sigmoid colon with primary ileo-ileal anastomosis and Hartmann's procedure was most commonly performed operation (37, 74%).

Most of the patients (26, 52%) had peritonitis/ peritoneal contamination, whereas 9 (18%) patients experienced hemodynamic instability intraoperatively. Following the procedure, 47 (94%) patients transferred to post anesthesia recovery unit, while the remaining 3 (6%) were admitted to the intensive care unit. **Table 3.**

Table 3: Intraoperative findings of patients operated for ISK at WUCSH, Wolkite, Ethiopia, from January 2020 to December 2025.

Variables	**Categories**	**N**	**%**
Type of ISK	Type I	29	58.0
	Type II	21	42.0
Gangrenous Bowel segment	None	3	6.0
	Ileum only	10	20.0
	Sigmoid colon only	11	22.0
	Both ileum and sigmoid colon	26	52.0
Class of ISK	Class I	1	2.0
	Class II	1	2.0
	Class III	2	4.0
	Class IV	19	38.0
	Class V	1	2.0
	Class VI	26	52.0
Intraoperative complications	Peritonitis/ Peritoneal contamination	19	38.0
	Peritonitis + Intraoperative shock	11	22.0
	Intraoperative shock	5	10.0

	None	15	30.0
Procedure	Resection and anastomosis	15	30.0
	Resection with colostomy/ileostomy	32	64.0
	Detorsion only	3	6.0
Length of surgery	< 3 hours	29	58.0
	≥3 hours	21	42.0

Postoperative outcomes

Poor postoperative outcome occurred in nearly half of patients with ileosigmoid knotting (46%; 95% CI: 31.8%–60.7%). Among the complication, surgical site infection is most common occurring in 9 (18%) patients. The duration of hospitalization ranged from 3 to 35 days. Out of four patients (8%) who had anastomotic leak, two of them required relaparotomy, as all patients who experienced wound dehiscence (4, 8%). Two patients died of refractory septic shock making the mortality rate 4%, after relaparotomy for anastomotic leak. Prolonged hospital stay experienced by 46% of patients. **Table 4.**

Table 4: Postoperative Outcomes of patients operated for ISK at WUCSH, Wolkite, Ethiopia, from January 2020 to December 2025.

Factors	Categories	N	%
Surgical site infection	NO	41	82.0
	YES	9	18.0
Anastomotic leak	NO	47	94.0
	YES	3	6.0
Surgical site infection + Anastomotic leak	NO	37	74.0
	YES	1	2.0
Hospital Acquired Pneumonia	NO	45	90.0
	YES	5	10.0
Wound Dehiscence	NO	46	92.0
	YES	4	8.0
Ileus	NO	48	96.0

	YES	2	4.0
ICU admission required	YES	3	6.0
	NO	47	94.0
Length of hospital stay (>**7**days)	No	27	54.0
	Yes	23	46.0
Condition of the patient on discharge	Alive and discharged	48	96.0
	Died	2	4.0
Cause of death	Septic shock	2	4.0

Factors associated with poor outcomes

In bivariate logistic regression analysis, variables: Age, Residence, Preoperative shock, Procedure, Preoperative diagnosis, bowel gangrene, Time to presentation, and Class of ISK were found to be a candidate variable with p-value<0.2. But, in the multivariable logistic regression only four variables: Age, bowel gangrene, preoperative shock, and duration of symptoms had statistically significant association at a p-value of <0.05. (Table 5).

Patients aged 50–59 years had 2.2 times higher odds of developing poor postoperative outcomes compared to those < 30 years (AOR = 2.20, 95% CI: 1.09-5.18). Similarly, patients aged ≥60 years were about twice higher odds of experiencing poor outcomes (AOR = 2.05, 95% CI: 1.03-4.07). This suggests that increasing age is predictor of adverse postoperative events, possibly due to reduced physiological reserve, compromised immunity, and higher vulnerability to surgical stress.

Patients with bowel gangrene involving both the sigmoid colon and ileum had nearly four times higher odds of poor postoperative outcomes compared to patients without gangrene (AOR = 3.84, 95% CI: 1.46-10.10). In addition, gangrene involving the sigmoid colon alone showed 1.73 times higher odds of developing poor postoperative outcomes (AOR = 1.73, 95% CI: 1.08-24.42). This indicates that bowel gangrene significantly worsens the prognosis, likely due to peritoneal contamination, higher risk of sepsis, and the need for more extensive bowel resection procedures, all of which contribute to poor postoperative recovery.

Patients presenting with shock had >4 times higher odds of poor postoperative outcomes compared to those without shock (AOR = 4.34, 95% CI: 1.48-12.69). This finding points the impact of hemodynamic instability on SSI, anastomotic leak and postoperative recovery.

Patients with duration of symptoms >48 hours were 11 times more likely to develop poor postoperative outcomes compared to those presenting within 24 hours (AOR = 11.03, 95% CI: 2.69-45.20). Even those presenting within 24-48 hours had nearly 3.6 times increased odds (AOR = 3.58, 95% CI: 1.08-11.80). This clearly demonstrates that delayed presentation substantially increases the risk of adverse outcomes, likely due to progression to gangrene, sepsis, and systemic complications.

Table 5: Factors associated with poor outcomes of patients operated for ISK at WUCSH, Wolkite, Ethiopia, from January 2020 to December 2025.

Variables	**Category**	**COR (95% C.I.)**	**p-value**	**AOR (95% C.I.)**	**p-value**
Age	<30	1		1	
	30-39	1.183 (0.488-4.933)	0.699	1.052 (0.243-11.739)	0.857
	40-49	0.612 (0.005-2.903)	0.235	0.952 (0.118-23.299)	0.663
	50-59	2.350 (1.927-5.685)	0.042*	2.202 (1.086-5.175)	0.048*
	≥60	2.955 (1.387-6.297)	0.005**	2.052 (1.034-4.070)	0.040*
Bowel Gangrene	None	1		1	
	Ileum only	0.869 (0.10-18.823)	0.220	0.232 (0.039-5.543)	0.122
	Sigmoid colon only	2.666 (1.120-6.181)	0.029*	1.729 (1.077-24.416)	0.044*
	Both sigmoid colon	4.515	0.001**	3.837	0.005**

	and ileum	(1.792-11.374)		(1.458-10.098)	
Pre-Operative shock	No	1		1	
	Yes	6.714 (1.917-145.766)	0.011*	4.338 (1.484-12.685)	0.007**
Duration of symptoms	<24 hours	1		1	
	24-48 hours	5.624 (1.200-26.349)	0.028*	3.578 (1.084-11.804)	0.036*
	>48 hours	10.236 (3.008-34.830)	<0.001**	11.027 (2.690-45.201)	0.001**

*p < 0.05, **p < 0.01

7. DISCUSSION

In this study, the findings showed that postoperative poor outcome remains high, occurring in 46% (95% CI: 31.8%–60.7%) of patients, a finding aligning with results in other studies, which reported complication rates of 40 - 65% [1, 7, 9, 10, 17]. This complication rate is higher than studies performed by Ooko et al. (24.6%), and Atamanalp SS (20.0–21.6%) [2, 18]. Of poor outcomes surgical site infection (18%) was the most common complication, followed by hospital-acquired pneumonia (10%), wound dehiscence (8%), and anastomotic leak (6%). Nearly half of the patients (46%) had a hospital stay longer than seven days, indicating significant postoperative morbidity despite survival. The mortality rate was found to be 4%.

Surgical site infection (SSI) was the most frequently reported postoperative complication in most studies, and our findings were consistent with these results [5-7, 11, 18]. From Ethiopian studies, Bitewa et al. reported similar finding (21%), but Abebe et al., and Bayleyegn et al. reported higher SSI rate (25% and 50% respectively) [6,16,17]. Hospital acquired pneumonia found to occur in 10% of patients, which is higher than report by Abebe et.al and lower than report by Bitewa et al., 3.6% and 23.9% respectively [6, 17]. The relatively lower rate of HAP observed in our study may be attributed to the small number of patients with comorbidities, which is consistent with the findings reported by Abebe et al. [6]. Wound dehiscence occurred in 8% of patients, a finding that align with existing reports [2, 6, 17]. Anastomotic leak was found in 6% of patients, entirely occurring in patients with double bowel segment gangrene. Authors also reported higher complication rate in this group [5-7, 11, 18]. Similar to a report by Abebe et al., this study showed anastomotic leak is higher in patients who experienced intra operative shock [6]. This is in favor of employment of stomas rather than resection and primary anastomosis in unstable and double bowel gangrene patients [2, 5, 6, 7, 11, 25]. Generally, mortality in ileosigmoid knotting can be reach up to 66.6% [2, 5, 6, 7-12, 18]. Mortality rate in Ethiopian studies reported by Abebe et al., and Betewa et al. is 21.4%, and 7.9% respectively. This study found a lower rate (4%) of death than most of the studies. This might be explained by the absence of associated comorbidity in our patients and performing stoma in unstable patients and significant peritoneal contamination. This study, and other

studies showed multiple organ failure (MOF) secondary to septic shock as the major cause of death [2, 5, 6, 7-12, 18, 26].

Advanced age was identified as an important determinant of poor outcome in several studies [2, 4, 5, 7-9, 16, 18]. Older age (>60 years) was associated with higher morbidity and mortality in patients managed for ISK [2, 8, 9]. In this study, increasing age was found to be statistically significantly associated with poor postoperative outcomes (p = 0.040; AOR = 2.052; 95% CI: 1.034–4.070), consistent with the report by Bayleyegn et al. which found age as significant predictor of mortality and time to death (p-value <0.05) [16]. These findings may be explained by higher likelihood of delayed presentation with greater risk of bowel gangrene, reduced physiological reserve, compromised immunity and healing responses in elderly patients [27]. However, inconsistent findings were reported in a study conducted at SPHMMC by Abebe et al., where age did not show a statistically significant association with poor outcome [6]. These variations may reflect differences in socio-demographics of study participants.

Preoperative shock is one of most common presenting features (in up to 60%) and was consistently reported as a strong predictor of poor outcomes of ISK operated patients in many studies [1, 5, 10, 11, 12, 16, 25]. Shock at presentation was identified in 20% of study cases, aligning with relatively similar findings by Abebe et al., and Ooko et al. [2, 6]. In this study preoperative shock was found to have significant association with postoperative poor outcome (P= 0.001, AOR= 11.027, CI: 2.690-45.201). Similarly, a study by Bayleyegn et al. found preoperative shock to be a significant predictor of poor outcome [16]. However, a study by Bitewa et al. reported no statistically significant association between shock at presentation and postoperative adverse events [17].

Delayed presentation was associated significantly with poor post operative outcome in this review with p-value: 0.001 (AOR= 11.027, 95% C.I. :2.690-45.201). Many studies reported patients presenting after 24 hours had significantly worse postoperative outcomes [1-2, 9, 12, 14, 17, 19-20]. Similar pattern was noted in this study with 60% of patients presenting after 24 hours of onset of symptoms. Of these, 40% came from rural area which mirrors lack of emergency surgical care in most of the rural Ethiopia [16]. However, several studies have

reported a higher rate of bowel gangrene and poor postoperative outcomes among patients operated for ISK, even in cases with early presentation. This finding may suggest that ISK has an aggressive clinical course, where rapid vascular compromise and strangulation can result in early bowel ischemia, sepsis, and subsequent poor outcomes, independent of symptom duration [1, 2, 17, 26].

The presence of bowel gangrene was consistently associated with poor postoperative outcomes in ISK and reported to significantly increase mortality rates [2, 9,12,14,18-19,20]. Aligning with these reports, this study showed gangrene rate of 94% and there is statistically significant association between the presence of bowel gangrene and post operative poor outcome in this review (p-value= .005 AOR: 3.837 (95% C.I: 1.458 – 10.098)) [16]. All deaths occurred among patients with double bowel gangrene and anastomotic leak, similar to a finding reported from SPMMC by Abebe et al. [6]. Many studies also identified gangrenous bowel as a significant predictor of poor prognosis among patients operated for ISK [10,19,21]. These may be explained by advanced vascular compromise and irreversible ischemic injury increasing the risk of bacterial translocation, endotoxemia, and subsequent sepsis, which may progress to septic shock and multiorgan failure. Additionally, bowel gangrene often requires extensive bowel resection, which increases operative risk and predisposes to postoperative complications such as anastomotic leak and surgical site infection. A Study from JUMC by Bayleygn et al., reported no statistically significant association between the duration of symptoms, and the status of bowel strangulation, but significant association gangrenous bowel and postoperative adverse events [16].

The high rate of postoperative poor outcomes (46%) observed in this study shows that ISK remains a significant surgical challenge with considerable morbidity, even in settings with relatively low mortality. The predominance of preventable complications such as surgical site infection and hospital-acquired pneumonia suggests the need to strengthen perioperative infection prevention strategies, optimize antibiotic stewardship, and enhance postoperative monitoring and respiratory care. Early recognition and aggressive resuscitation of patients presenting with shock are crucial to improve outcomes. The strong association between delayed presentation and adverse outcomes underscores the need to improve timely access to emergency surgical care, particularly in rural areas. Community awareness, improved referral

systems, and expansion of emergency surgical services may help reduce delays. The very high rate of bowel gangrene (94%) and its strong association with poor outcomes emphasize the importance of prompt diagnosis and early surgical intervention before irreversible ischemic damage occurs. Furthermore, the occurrence of anastomotic leak exclusively in patients with double bowel gangrene and intraoperative instability supports the selective use of diversion stomas rather than primary anastomosis in unstable patients.

Strengths and Limitations of the study

This study is the first review at WUSTH on ileosigmoid knotting reviewing six years data. The study assessed magnitude of poor postoperative outcomes and identified statistically significant associated factors contributing valuable evidence that may guide risk stratification and early intervention strategies. The findings contribute to the limited body of literature on ISK in Ethiopia and similar settings.

This study has several limitations. Being retrospective cross-sectional study may have affected the availability and accuracy of some variables due to incomplete or inconsistent records. The relatively small sample size may have reduced the statistical power to detect significant associations between certain factors and poor outcomes. The cross-sectional nature of the study does not allow conclusions about cause-and-effect relationships between the identified factors and poor outcomes. Since the study was conducted in a single institution, the findings may not fully represent the situation in other hospitals with different patient characteristics, levels of resources, and surgical practices. Long-term postoperative outcomes could not be evaluated because these data were not routinely documented.

8. CONCLUSION AND RECOMMENDATIONS

8.1. Conclusion

This study demonstrated that nearly half of the patients experiencing poor postoperative outcomes among adult patients operated for ISK. Advanced age, preoperative shock, delayed presentation, and the presence of bowel gangrene were identified as independent predictors of poor postoperative outcomes. These findings highlight the critical importance of early diagnosis, timely surgical intervention, aggressive resuscitation, and appropriate intraoperative decision-making, including consideration of stoma formation in unstable patients, to improve outcomes. Overall, this study provides important local evidence that can inform clinical practice and guide strategies aimed at reducing morbidity and mortality associated with ISK.

8.2. Recommendations

Based on the high rate of poor postoperative outcomes (46%) and the identified associated factors: advanced age, preoperative shock, delayed presentation, and bowel gangrene several actions are recommended to improve patient outcomes. Healthcare providers at primary and secondary health facilities should strengthen early recognition of intestinal obstruction and timely referral of suspected cases to specialized centers to reduce delays, particularly for rural patients. Surgeons and emergency teams should prioritize aggressive preoperative resuscitation and hemodynamic stabilization, especially in patients presenting with shock, and consider stoma creation rather than primary anastomosis in unstable patients and those with double bowel gangrene to minimize complications. Hospital administrators should enhance emergency surgical capacity, referral systems, and infection prevention protocols to reduce the incidence of surgical site infections and other postoperative complications. Public health interventions aimed at increasing community awareness about early presentation for acute abdominal emergencies may also help reduce delayed presentation and associated morbidity.

For future research, prospective multicenter studies with larger sample sizes are recommended to strengthen generalizability and investigate causal relationships. Studies should also evaluate long-term postoperative outcomes, nutritional status, quality of life, and detailed pre-hospital delays, as these were not assessed in the current study due to its retrospective design. Such

evidence will further guide interventions to reduce poor outcomes among patients with ileosigmoid knotting.

REFFERENCES

1. Molla, Yohannis Derbew, Mensur Osman Yasin, and Samrawit Andarge Kassa. Ileosigmoid knotting: a case series of 25 patients. Int J Surg Case Rep. 2023;104:108107.
2. Philip Blasto Ooko et al. Ileo-sigmoid knotting: a review of 61 cases in Kenya. Pan African Medical Journal. 2016; 23:198.
3. J Shepherd, ninety-two cases of ileosigmoid knotting in Uganda, British Journal of Surgery, Volume 54, Issue 6, June 1967, 561–566
4. Atamanalp SS, Disci E, Peksoz R, Atamanalp RS, Atamanalp CT. Ileosigmoid knotting: A review of 923 cases. Pak J Med Sci. 2022 Mar-Apr;38(3Part-I):711-715
5. Atamanalp SS. Ileosigmoid knotting: One of the largest single-center series. Pak J Med Sci. 2018;34(3):761-763.
6. Abebe K, Sherefa K, Teshome H, Abebe E. Ileosigmoid Knotting: Analysis of Patients Clinical Profiles and Determinants of Outcomes. Surg Res Pract. 2020 Jul 23;2020:3826138.
7. Alver O, Oren D, Tireli M, Kayabaşi B, Akdemir D. Ileosigmoid knotting in Turkey. Review of 68 cases. Dis Colon Rectum. 1993; 36(12)
8. Machado NO. Ileosigmoid knot: a case report and literature review of 280 cases. Ann Saudi Med. 2009 Sep-Oct;29(5):402-6.
9. Atamanalp SS, Ozturk G, Aydinli B, Yildirgan MI, Basoglu M, Oren D, et al. A new classification for Ileosigmoid knotting. Turk J Med Sci 2009; 39:541-5.
10. Kotisso B, Bekele A. Ileosigmoid knotting in Addis Ababa: a three-year comprehensive retrospective analysis. East Cent Afr J Surg. 2006;44(4):377–83.
11. Mandal A, Chandel V, Baig S. Ileosigmoid knot. Indian J Surg. 2012;74(2):136–42.
12. VRaveenthiran S. Ileosigmoid knot. Dis Colon Rectum. 2001;44(8):1196–200.
13. David E. Beck and Santhat Nivatvongs. Volvulus of the Colon. In: Gordon, Nivatvongs, editors. Principles and Practice of Surgery for the Colon, Rectum, and Anus. 4th ed. Philadelphia: Elsevier; 2019. P. 686 – 88.
14. Osiro S, Cunningham D, Shoja MM, et al. The twisted colon: a review of volvulus and related colonic pathologies. Int J Colorectal Dis. 2012;27(7):851–61

15. Mbanje C, Mungazi SG, Muchuweti D, Mazingi D, Mlotshwa M, Maunganidze AJV. Ileo-sigmoid knotting: the Parirenyatwa hospital experience. S Afr J Surg. 2020 Jun;58(2):70-73
16. Bayleyegn NS, Zelelew AN, Sisay AL. Evaluation of clinical profiles, surgical experience and outcomes of ileosigmoid knotting in low-resource setup: A retrospective cohort study at Jimma University Medical Center. World Journal of Surgery. 2024 Jun;48(6):1331-47.
17. Bitewa DA, Dagmawi T, Bogale M, Miskir M, Abiy D, Dessalegn M. Clinical profile and treatment outcome of patients with ileo-sigmoid knotting, an experience from Ethiopian setting: a six-year review. BMC Surg. 2025 Apr 22;25(1):171.
18. Atamanalp SS. Ileosigmoid knotting: clinical appearance of 73 cases over 45.5 years. ANZ J Surg. 2013 Jan;83(1-2):70-3.
19. Bekele A, Tegegne A, Tadesse A. Surgical management and outcome of ileosigmoid knotting at a teaching hospital in Ethiopia. East Cent Afr J Surg. 2017;22(1):37–42.
20. Kedir M, Abate E, Asrat H. Clinical profile and outcome of patients operated for ileosigmoid knotting in a teaching hospital in Northern Ethiopia: a retrospective study. BMC Surg. 2022;22:112.
21. Tadesse A, Mekonnen D, Belayneh T. Outcomes of intestinal obstruction and its determinant factors among surgically treated patients in Jimma University Medical Center. Ethiop J Health Sci. 2019;29(2):219–28.
22. Bain K, Lelchuk A, Nicoara M, Meytes V. A unique surgical emergency: ileosigmoid knotting. AME Case Rep 2018; 2:29.
23. Sseruwagi TM, Lewis C. Ileosigmoid Knotting: A Case Series. Cureus. 2022 Nov 29;14 (11)
24. Kidane AY. Ileosigmoid knotting: A rare cause of acute intestinal obstruction and peritonitis. J Case Rep Images Surg 2024;10(1):42–47.
25. C. Banerjee, M. Mukhopadhyay, A. Roy, J. Kumar, S. Mukherjee, and Q. M. Rahman, “The unusual volvulus: a five-year retrospective analysis of nine cases,” Indian Journal of Surgery, vol. 76, no. 2, pp. 100–103, 2014.
26. Kevin Bain AL, Nicoara M, Meytes V. A unique surgical emergency: ileosigmoid knotting. AME case Rep, 2018. 2018;2:29.

27. Peters, X.D., Russell, M.M. Patient Centered Outcomes After Surgery in the Older Adult. *Curr Geri Rep* 13, 78–85 (2024).

ANNEXE

Data Extraction Checklist

Part 1: Sociodemographic Information

1) Patient Medical Record Number: _____

2) Age (in years): <20 □ 20-29 □ 30-39 □ 40-49 □ 50-59 □ ≥60 □

3) Sex: Male □ Female □

4) Residence: Urban □ Rural □

6) Date of Admission: _____/_____/_____

7) Date of Discharge or Death: _____/_____/_____

Part 2: Pre-operative Patient Condition

8) Time to presentation (in hours): _____

9) Vital signs at admission:

- □ Temperature: _____°C
- □ Preoperative shock (SBP< 90/60): NO □ YES □
- □ Tachypnea: NO □ YES □
- □ Tachycardia: NO □ YES □

10) Preoperative hemoglobin/hematocrit _____g%/ _____%

11) Preoperative diagnosis:

- □ Ileosigmoid knotting suspected
- □ Small bowel obstruction

- ☐ Large bowel obstruction
- ☐ Mixed bowel obstruction
- ☐ Mesenteric ischemia

12. Any pre-existing comorbidities (check all that apply):

- ☐ Hypertension
- ☐ Diabetes Mellitus
- ☐ Heart disease
- ☐ Renal disease
- ☐ None

13. ASA grade

- ☐ Grade I
- ☐ Grade II
- ☐ Grade III
- ☐ Grade IV
- ☐ Grade V

Part 3: Intraoperative Findings

14. Type of ileosigmoid knotting:

- ☐ Type I
- ☐ Type II
- ☐ Type III
- ☐ Type IV
- ☐ Not documented

15. Gangrenous bowel segment:

- ☐ Ileum only
- ☐ Sigmoid colon only
- ☐ Both ileum and sigmoid colon
- ☐ None

16. Any complications identified during surgery:

- ☐ Peritonitis/Peritoneal contamination
- ☐ Peritonitis plus Intraoperative shock
- ☐ Intraoperative shock
- ☐ None

17. Class of ISK

- ☐ Class I
- ☐ Class II
- ☐ Class III
- ☐ Class IV
- ☐ Class V
- ☐ Class VI

18. Procedure done:

- ☐ Resection and anastomosis
- ☐ Resection with stoma creation (colostomy/ileostomy)
- ☐ Detorsion only
- ☐ Others (specify): _____

19. Length of surgery: _____hrs.

Part 4: Postoperative Outcomes

20. Postoperative complications (if any) (check all that apply):

- ☐ Surgical site infection (SSI)
- ☐ Anastomotic leak
- ☐ Ileus
- ☐ Pneumonia
- ☐ Wound dehiscence
- ☐ Others (specify): _____
- ☐ None

21. Duration of hospital stay (in days): _____

22. ICU admission required? Yes ☐ No ☐

23. Final outcome:

- ☐ Recovered and discharged
- ☐ Died

24. If death occurred, indicate cause: _____