DETERMINANTS OF SURGICAL OUTCOMES OF SMALL INTESTINAL ATRESIA AT KENYATTA NATIONAL HOSPITAL, KENYA

A DISSERTATION SUBMITTED AS PART FULFILMENT FOR THE AWARD OF MASTER OF MEDICINE IN PAEDIATRIC SURGERY,

UNIVERSITY OF NAIROBI

DR. FRANCISCA SYOVATA MUNYALO

M.MED PAEDIATRIC SURGERY

H58/86892/2016

Email: fsyovata@gmail.com

DECLARATION

This research is my original work and it has not been undertaken before, neither has any publication on the subject matter been done. Whenever I have used any person's work, I have accordingly acknowledged and referenced it.

Dr. Francisca Syovata Munyalo

Principal Investigator

Signature_____ Date 10/9/21

SUPERVISORS' DECLARATION

This research has been submitted with the approval of the following supervisors:

Dr. Francis Osawa

MBChB (UoN,), M.MED Surgery (UoN)

Lecture and Consultant Paediatric surgeon

Department of surgery

University of Nairobi

Signature Date …10/9/2021……

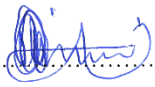
Dr. Peter Mwika

MBChB (UoN), M.MED Paediatric Surgery (UoN)

Lecturer and Consultant Paediatric Surgeon

Department of surgery

University of Nairobi

Signature ……  …… Date……10/9/2021……

Dr. Paul Odula

BSc(Hons); MBChB(UoN); M. Med Surgery(MUK); PhD

Senior Lecturer and Consultant Surgeon

Department of Human Anatomy

University of Nairobi

Signature…… Date……10/9/2021……

Research Assistants

Dr. Hetal Gohil

MBChB (UON)

Paediatric Surgery Registrar year 4

Department of Surgery

University of Nairobi

Dr. Abubakar Said

MBChB (Yemen)

Paediatric Surgery Registrar Year 4

Department of Surgery

University of Nairobi

Statistician

Wycliffe Ayieko

Department of Public Health

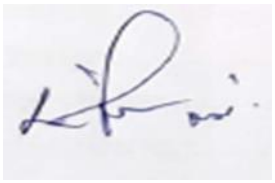
University of Nairobi

waiyeko@gmail.com

DEPARTMENTAL APPROVAL

This research proposal was submitted at the general surgery department meeting at the University of Nairobi held on ……14/1/2021……. and is hereby approved for presentation at the Kenyatta National Hospital-university of Nairobi Ethics and Research Committee.

Dr. Julius Kiboi Githinji
MBChB (UoN) M.MED (UoN)
Senior Lecturer and Consultant Neurosurgeon
Department of Surgery
University of Nairobi

Signature  Date……10/9/2121……

LIST OF ABBREVIATIONS

CNS: Central Nervous System

CVS: Cardiovascular System

DA: Duodenal atresia

GIT: Gastrointestinal System

ICU: Intensive Care Unit

JIA: Jejunoileal atresia

KNH: Kenyatta National Hospital

MSS: Musculoskeletal System

RESP: Respiratory System

SIA: Small Intestinal Atresia

UON: University of Nairobi

LIST OF FIGURES **Page**

LIST OF TABLES

Table of Contents

ABSTRACT

Background: Small intestinal atresia is the third most common cause of intestinal obstruction in neonates. Advancements in the perioperative management of these patients have led to better survival rates and outcomes in developed countries, however, such outcomes in the developing countries have not been recorded. Several factors such as age at surgery, associated anomalies, type of atresia, availability of neonatal ICU and Total Parenteral Nutrition, time taken to reach full feeds, have been found to have an influence on the outcome of these patients.

The study aimed to establish determinants of surgical outcome of small intestinal atresia at Kenyatta National Hospital.

Study objective: To determine the factors that affect surgical outcomes of small intestinal atresia at Kenyatta National Hospital.

Study design: A retrospective cross-sectional study

Methods: Records of neonates admitted to Kenyatta National Hospital with a diagnosis of small intestinal atresia from January 2014 to October 2020 who fit the inclusion criteria were retrieved. Data on demographics, clinical findings, perioperative findings and outcomes were extracted.

Data management and analysis: Data collected was entered into spreadsheets and analyzed using SPSS version 24 software to determine any significant relationships. Data was then summarized into frequencies and percentages for categorical data and mean with standard deviation for continuous data. Factors influencing the surgical outcome were analyzed with Pearson Chi square tests and those with significant associations were subjected to multivariate analysis with use of logistic regression.

Results: 135 patient files were studied. Significant factors which influenced mortality were presence of associated anomalies, type of atresia and use of TPN. The most common complications encountered were anemia, jaundice and sepsis. Mortality was at recorded at 56.3%.

Conclusion: The mortality rate seen at KNH is high. Though the factors which have been found to increase the survival rate of SIA in developed countries are available at KNH, they are few and strained to cater for all neonates at KNH. It is recommended to increase the capacity of NICU at KNH and to have CVC inserted so as to facilitate TPN administration.

Study utility: The study will pave way for the development of new management protocols that can be practiced at KNH which will lead to improved short and long term outcomes. Information gained from this study will aid in updating healthcare workers at peripheral facilities on pre-transfer stabilization and optimization of these neonates.

Key terms: intestinal, atresia, outcomes

CHAPTER ONE: INTRODUCTION

Small intestinal atresia is a congenital anomaly in which there is complete obstruction of the lumen of the small intestine. The incidence of small intestinal atresia is 1.6 to 2.9 per 10,000 births as per Best et al and stand at 3.4 per 10,000 live births for small intestinal atresia in the United States of America, thus it is a common disease. (1)

Two major theories of the etiology have been postulated: Tandler's concept of lack of vacuolation of the solid stage of intestinal development and the classic study by Louw and Barnard suggesting that a late intrauterine mesenteric vascular accident is the cause of most jejunoileal atresia. Intrauterine vascular accidents occur as a result of volvulus, intussusception, internal hernia, or tight gastroschisis (vanishing gastroschisis). Familial instances of jejunoileal and colonic atresia have also been observed, suggesting that genetics may play a part in such cases. (2)

Clinical presentation of SIA patients is of bilious vomiting early in life, failure to pass meconium or little amount of stool, and may be associated with abdominal distension. Antenatally, the diagnosis is made by the presence of dilated air bubbles, polyhydramnios and detection of other anomalies. Management of these patients involves reestablishing normal fluid and electrolyte balance, surgical management of the proximal and distal ends of the bowel, establishing adequate nutrition and addressing complications that may occur.

In comparison to the developed countries, small intestinal atresia has been noted to have a greater level of morbidity and mortality in the developing countries in Africa. A mortality rate of 15-41% (3) recorded in West Africa has been attributed to late presentation, financial constraints, lack of basic facilities, presence of multiple anomalies, aspiration, sepsis, gut perforation, and bowel gangrene which were the main contributors to death of the patients. (4)

Significant improvements that have occurred over the years in developed countries have led to improvement and survival of patients with intestinal atresia; these include access to prenatal

diagnosis, neonatal intensive care, timely surgical intervention with neonatal anesthesia and parenteral nutrition (2) thus mortality rate has improved to 4-11% from 30-50%. (5)

This study seeks to identify the gaps in patient management which may give insights into the dismal survival rates of the patients at Kenyatta National Hospital, yet at our facility, there is availability of equipment and services that have led to an improvement of survival rates in the developed countries. These include availability of total parenteral nutrition, ICU and imaging services which facilitate prenatal diagnosis.

Information gained from this study will help in development of standard protocols for management of neonates with small intestinal atresia which would aid in attaining improved outcome. Dissemination of information to healthcare workers at peripheral facilities will aid in improving preoperative optimization of these patients and timely referral.

CHAPTER TWO: LITERATURE REVIEW

2.1. Pattern of clinical presentation

Patients with SIA usually present with symptoms of intestinal obstruction such as bilious vomiting from the first day of life, associated with abdominal distension and passage of small volume stool that is either greenish or mucoid pellets. Jaundice which is characteristically associated with an elevation of indirect bilirubin occurs in 32% of infants with jejunal atresia and 20% of those with ileal atresia (6) Whereas the vomitus is most often bilious, it may be nonbilious, as 15% of defects within the duodenum occur proximal to the ampulla of Vater. (7)

The use of antenatal ultrasound has aided in detecting SIA diagnosis prenatally, depicted as the classical double bubble sign in DA and triple bubble in JIA, avoiding the morbidity and mortality of late presentation. (8) Ultrasound features suggestive of JIA such as polyhydramnios was recorded on obstetrical records in 23 cases and dilated fetal bowel loops in 15 out of 43 at a mean gestational age of 36 weeks (range 27–41weeks gestation) (9)

However, in low and middle-income countries most of these cases are not identified prenatally due to financial constraints or inexperience of the sonographer to the surgical diagnosis. Early detection of small intestinal atresia enables planning of referral to a tertiary center for management and avoids complications brought about by late diagnosis.

Patients with SIA diagnosed postnatally present late to health facilities. This is associated with poor nutritional status of the patient due to the protracted vomiting, dehydration and deranged electrolytes. In Uganda, the average age at presentation for duodenal atresia was 7.14 days and 6.7 days for JIA. (10) The age of presentation of JIA ranged from 1-28 days with a median age of 4 days. 63.2% of the patients presented after 48 hours of life. (3) Lack of awareness of the condition among healthcare workers in peripheral centers contributes to the late presentation of these patients.

S. Cairo et al recorded the mean birth weight at presentation as 2.2kg for DA and 2.12kg for JIA; whereas a mean birth weight of 2.644 g (range 730g – 4.120g) for JIA was noted by Calisti et al.

Birth weight of less than 2kg has been identified as a risk factor for prolonged hospital stay and mortality. (11)

Classification of duodenal atresia according to Gray and Skandalakis` is as follows:

(12)

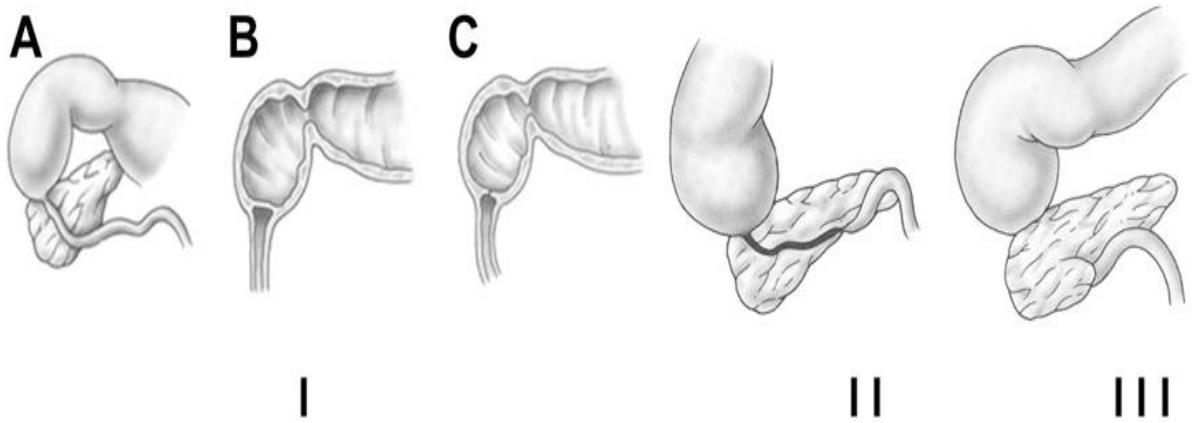
Type I: A mucosal diaphragmatic membrane obstructs the lumen. (92% incidence)

Variations occur where there is an imperforate septum, a central perforation or a windsock.

Type II: The proximal and distal segments of the duodenum are connected by an atretic cord. (1% incidence)

Type III: The proximal and distal segments of the duodenum are completely separated by a gap in the mesentery (7% incidence)

Figure A-classification of duodenal atresia (13)



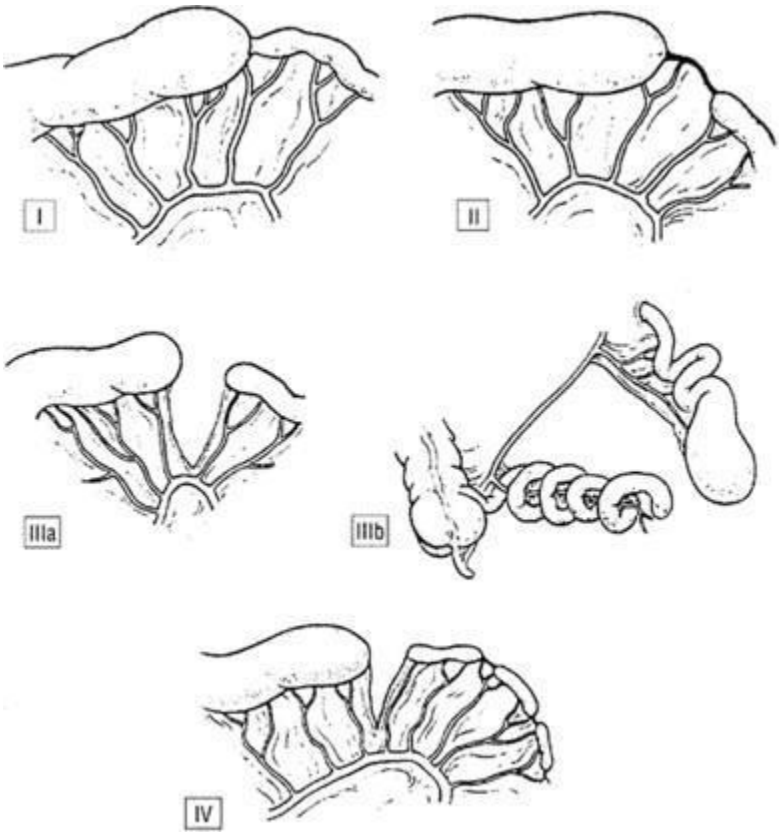


Figure B- classification of jejunoileal atresia (14)

Classification of jejunoileal atresia by Grossfeld and colleagues as:

Type I: mucosal (membranous) atresia with intact bowel wall and mesentery.

Type II: atretic ends are separated by a fibrous cord.

Type IIIa: blind ends are separated by a V-shaped (gap) mesenteric defect.

Type IIIb: apple-peel atresia.

Type IV: multiple atresia (a string of sausages).

Severe types of JIA, which include type IIIb and type IV, have been associated with a higher rate of mortality compared to other types of atresia (15).

Forrester et al, in a population-based study, found that the maternal age risk for small intestinal atresia was noted in extremes of ages whereas the maternal age of >35 years was associated with a high rate of duodenal atresia (16).

2.1.1 Associated anomalies.

In a register-based study done by Best et al, 215 (20.6%) patients were found to have a chromosomal or genetic syndrome, which included 200 (30.8%) with duodenal atresia and 15 (3.8%) with JIA out of a total of 1044 cases (17).

173 (16.6%) patients had Down syndrome, in which 170 (16.3%) cases were associated with duodenal atresia and JIA in three cases. There were 30 syndromic cases, which included Patau syndrome, Edward syndrome, triploid and VATER (V-vertebrae anomalies, A-anal atresia, TEF-tracheoesophageal fistula, R-renal anomalies) anomalies. (17)

Duodenal atresia is associated with Down's syndrome (30%), annular pancreas (23%), congenital heart disease (22%), malrotation (20%), esophageal atresia (8%), others (20%) (18)

Patients with associated anomalies have a mortality rate of 7% and thus associated anomalies has been noted as an independent risk factor of mortality. Such patients also presented with low birth weight which further increased the mortality risk. (19)

2.2 Perioperative management

There are set guidelines for management of neonates who have undergone intestinal surgery that are aimed at attaining optimal care of these patients. Key in the perioperative management of the patient is establishment of a structured multidisciplinary team which prevents adverse outcomes and ensures continuity of care. (20)

2.2.1. Preoperative management

Preoperative management is paramount with the aim of normalizing the physiology of the patient in terms of fluid and electrolyte balance, the level of hemoglobin (Hb) and treatment of sepsis and such parameters are followed sequentially postoperatively until discharge of the patient. The hemoglobin level for stable neonates should be maintained at ≥9 g/dL whereas neonates with respiratory distress which may necessitate intervention require a hemoglobin level of ≥11 g/dL (20)

Rajiv Chadha et al noted that late presentation or diagnosis with hypovolemia and electrolyte imbalance were significant preoperative findings in SIA patients. Aggressive resuscitation is one of the main factors that led to improved results of SIA patients with the number of survivors increasing from 25 to 75%. (21)

As a prophylaxis for surgical site infections, antibiotics should be given within one hour before the skin is incised. (20)

2.2.2 Intraoperative management

Judicious fluid management has been advocated for in order to maintain normovolemia, euglycemia and electrolyte balance, however, no specific regimens have been agreed upon. The core temperature is monitored to maintain normothermia and aid in preventing respiratory adverse events. (20)

2.2.2.1 Surgical management

Planning of the surgical procedure should be individualized according to the pre-operative condition of the patient, the location of atresia and the degree of dilatation of proximal bowel segment. (22).

The Kimura diamond-shaped duodenoduodenostomy is the most commonly performed procedure for DA. Other procedures described include duodenotomy with excision of the web in type 1 A and Duodeno-jejunostomy. In JIA, surgical procedures employed include resection and anastomosis, plication, or tapering enteroplasty in order to reduce the diameter of the proximal dilated segment.

Primary anastomosis was found to give better outcomes in all types of jejunoileal atresia with or without complication which reduced the postoperative morbidity and mortality compared to patients with enterostomy. (23) In patients with severe intestinal atresia, chimney procedures may be used in their management. The Bishop–Koop procedure for severe jejunoileal atresia was noted to have a low complication rate and re-operation rate, and the nutrition status at stoma closure was superior to double-barreled enterostomy. (24)

The proximal bowel histopathological changes tend to affect the neonate's postoperative outcome (25). It has been found that there is a remarkable decrease in Interstitial cells of Cajal in the small bowel wall of SIA patients (26). The most common area for abnormally thickened muscle layer lies about 5 cm proximal to the atretic end and it appeared that about 11 cm of the bowel needs to be resected for better outcome. (25) In order to avoid functional postoperative obstruction and abnormal motility of the proximal bowel that is retained, there may be a need to excise the dilated segment of the JIA up to the ligament of Treitz (22).

There are alternative procedures such as proximal tapering enteroplasty or the use of an intestinal plication to be able to preserve the length of the bowel and facilitates the early establishment of feeds in proximal jejunal atresia. (27)

Location of the atresia affects the duration to full enteral nutrition whereby jejunal atresia requires a longer time than duodenal atresia. It however does not affect mortality or length of stay. (17)

2.2.3 Postoperative management

The postoperative care of small intestinal atresia patients is paramount in the outcome of these patients. Postoperative analgesia as per ERAS guidelines involves use of acetaminophen as a regular dosage initially, however, breakthrough pain can be managed with the least effective opioid dose as well as continuing the use of regional analgesia. For reduction of procedural pain, lingual dextrose can be used.

In general, early enteral feeding within 24-48 hours is advocated for in post-surgical neonates as patients were found to have a shorter length of stay, decreased surgical site infections and a decrease in the frequency of anastomotic leaks. Low volume feeds introduced to the very low birth weight infants early, showed no propensity to raise the incidence of necrotizing enterocolitis and a reduction in sepsis as a complication. (20)

Review of the physiology of postoperative ileus has shown that paralysis of the small bowel is transient; that gastric paralysis lasts 24 hours and paralysis of the colon lasts for 48 to 72 hours. The etiology of ileus is unclear; it may be attributed to intra-operative bowel manipulation, anesthetic agent, perioperative narcotics and post-operative sympathetic hyperactivity. Post-operative ileus following intestinal resection has been managed by intravenous hydration, no oral intake, re-insertion of nasogastric tube, parenteral nutrition, clinical and radiological evaluation of the abdomen. (28)

Factors which predispose neonates with intestinal atresia to postoperative oral feeding difficulty include meconium peritonitis, luminal discrepancy, number of anastomoses, presence of immature ganglion and short bowel syndrome. (29) Sholadoye et al found that within 1 week, more than 70% of patients expressed normal bowel motility. All surviving patients established oral feeding by the 15th day of surgery where at the time total parenteral nutrition was not available, thus, the oral feeds were key in the survival of patients. (30) Breast milk has been advocated to be the initial form of nutrition as it contains factors such as immunoglobulins and growth factors which aid in the adaptability of the neonatal intestines. (20)

Neonates on parenteral nutrition, who undergo major surgery where they are adequately anesthetized and receive appropriate analgesics will at most need a slight increase in energy intake (about 15%) in the immediate postoperative period (about 4 h after surgery).

It has also been shown that the protein turnover does not increase significantly during this period. In case of extensive bowel resection, ranitidine is effective in reducing gastric hypersecretion that may cause electrolyte imbalance. (31)

Recent large series describe the use of short-term/long-term TPN in as many as 23 to 73% of patients of JIA. Use of TPN is especially useful in patients with type IIIb atresia, type IV atresia, or in cases with short-bowel syndrome. (32)

A predominant complication is dependency on parenteral nutrition especially for those with short bowel syndrome. Out of 118 patients on parenteral nutrition due to SIA,14 joined the intestinal rehabilitation program where their mean energy requirement from parenteral nutrition dropped from 87% to 14% and 10 patients fully weaned off parenteral nutrition and were able to avoid the need for transplantation, subsequently all patients resolved their cholestasis during an average of 12 weeks. (25) Recent advancements in intestinal transplantation coupled with incorporation of growth factors in management of patients with short bowel syndrome aid in attaining better outcomes. (2)

The urinary sodium of patients with stomas should be monitored and maintained at a urinary sodium greater than 30 mmol/L so as to improve the overall growth in surgical neonates. Mucous fistula refeeding has been shown to increase overall weight gained and have fewer complications such as liver function derangement, dependence on parenteral nutrition and breakdown of anastomosis site as it helps in further absorption of enteral feeds. (20)

Ideally, admission to the neonatal ICU is directed by the Surgical Apgar Score (SAS) which takes into account the estimated blood loss, the lowest mean arterial pressure and the lowest heart rate. Patients with low SAS had worse functional status and were associated with higher postoperative morbidity and mortality. Neonates with severely deranged acid-base balance, respiratory distress requiring mechanical ventilation, and sepsis or hypovolemia which

necessitates inotrope infusion would benefit from management at the ICU with close monitoring of the patients' physiology. (33)

2.3 Outcome

Common complications postoperatively included anastomotic leak, proximal perforation, functional obstruction, aspiration pneumonitis and wound infection. (22) In Kenya, Barrack et al observed complications such as prolonged feeding difficulty with poor weight gain, aspiration pneumonia and septicemia.

The risk factors for mortality identified as per Shakya et al included leucopenia and neutropenia where sepsis was the leading cause of mortality at 87.5%. (15) Other laboratory parameters that can be engaged to evaluate the patient's physiology and ability to have a robust healing process include postoperative hemoglobin and acute phase reactants such as albumin. Continued follow up by the neonatologist would assure maintenance of homeostasis, however, no study has been able to directly show the impact of such follow up apart from patients admitted in the neonatal ICU.

Multiple studies have shown a mean duration of 3 weeks to intake of full enteral feeds with significant correlation to residual bowel length and associated birth anomalies, patients with a short intestinal length tend to be dependent on parenteral nutrition for a longer period.

Length of hospital stay is associated with location of the atresia with a longer duration noted in patients with jejunal atresia compared with duodenal atresia. Postoperative complications also have been noted to increase the length of stay. (11)

The surgical outcomes of small intestinal atresia at KNH recorded an overall mortality rate of 41.9% where 25 out of 62 patients died (34), whereas a mortality rate of 34.2% has been noted in Nigeria (30) and 43% mortality rate in Uganda (10). In comparison to the outcomes in Washington, the survival to hospital discharge of patients with small intestinal atresia was 95% for all patients and 100% for those with isolated atresia (35).

2.4 JUSTIFICATION OF STUDY

There has been a steady increase in the number of patients admitted with small intestinal atresia at KNH and as such it is a common disease.

The outcome and survival of these patients at KNH from anecdotal reports are poor yet. Some of the factors which have been noted to improve the outcomes in developed countries such as a neonatal ICU, total parenteral nutrition and the ability to make a prenatal diagnosis are available at KNH.

An audit of the factors influencing the outcomes in SIA would be able to bring out the gaps in the management of these patients and come up with management protocols to be employed at the KNH that would aid in improving our outcomes.

The information gained from this study would aid in updating healthcare workers at peripheral facilities on pre-transfer stabilization and optimization of these neonates.

2.5 Study question: What are the factors influencing the surgical outcomes of small intestinal atresia at Kenyatta National Hospital?

2.6 Study objectives

2.6.1Main Objective

To determine the factors that affect the surgical outcomes of small intestinal atresia at Kenyatta National Hospital in Kenya.

2.6.2 Specific Objectives

1. To determine the clinical presentations of neonates with small intestinal atresia at KNH
2. To determine the perioperative management of neonates with small intestinal atresia at KNH
3. To determine the outcomes of surgery in neonates with small intestinal atresia at KNH

CHAPTER THREE: METHODOLOGY

3.1 Study Design

This was a retrospective cross-sectional study conducted among neonates admitted for management of small intestinal atresia at the Kenyatta National Hospital**.**

3.2 Study Site

The study was conducted at the Kenyatta National Hospital, Nairobi Kenya.

KNH hospital is the largest referral hospital in Kenya in Nairobi County. The hospital has a total bed capacity of 1800 and with functional surgical, pediatric, medical, obstetrics and gynecology units, 24 theatres, 20-bed HDU/ICU and a neonatal ICU. It also has a functional imaging department with an X-ray, ultrasound, CT scan and MRI.

The initial point of care of neonates with small intestinal atresia is at the Pediatric Emergency Unit or the NBU. Other patients are admitted to the pediatric wards before transfer to the pediatric surgical ward for definitive management. Where the diagnosis is made antenatally, the patient is admitted directly into the pediatric surgical ward.

3.3 Study Population

The study population were neonates admitted to the pediatric surgical ward for the management of small intestinal atresia between January 2014 and October 2020 at the Kenyatta National Hospital.

3.3.1 Inclusion Criteria

All neonates with small intestinal atresia who have been operated on at KNH.

3.3.2 Exclusion Criteria

All neonates who had a prior surgical intervention of the small bowel atresia at a hospital other than KNH.

3.4 Sample Size

The sample size for this study included all patients admitted with a diagnosis of small intestinal atresia and surgically managed at KNH between January 2014 and October 2020.
The total number of patients admitted at KNH with small intestinal atresia within the said period was known to be 221 as per the records at KNH Records Department.

All the 221 patient records were included in this study.

3.5 Sampling Procedure and Study Enrollment

Non-probabilistic consecutive sampling procedure where all eligible neonates with small intestinal atresia were enrolled. This was carried out at the records department.

3.6 Study Variables

OBJECTIVE	VARIABLES	SOURCE
Clinical presentation	Biodata, symptoms, associated anomalies, type of atresia	File
Perioperative management	Surgical procedure, laboratory investigation, use of TPN, admission to NICU, complications	File
Outcome	Time to full enteral feeds, length of hospital stay	File

3.7 Ethical Considerations

The study proposal was submitted to the KNH-UON ethics and research committee(ERC) for approval.

All patients' information was held in confidentiality and used for the purpose for which this study was intended only. This study does not include any invasive processes. There was no extra cost encountered by the patient. The findings of the study shall be disseminated to the KNH and the University of Nairobi, presented in medical conferences, and published in medical journals and public media where necessary for the benefit of the medical profession and the lay public.

3.8 Quality Assurance

The researcher trained two research assistants for one week in the handling of data to improve the quality of abstracted data. The research assistants are two level IV pediatric surgical residents at the University of Nairobi. The researchers strictly adhered to the study protocol. Cleaning and duplication was done before data analysis and the procedures documented.

3.9 Data Collection

This was done by the principal investigator and research assistants. Data collected included the patients' clinical information including biodata, perioperative management and other clinical information as captured in the patient's files after receiving permission to access the information from the hospital management.

The files were retrieved from the filing area and using a separate room, the information was extracted from the file before returning them to the filing area.

The data extracted was filled in the data collection tool. The collected data was identified by assigning study-specific unique identifiers to the study participants.

All electronic data was stored in an external hard drive and password protected after encryption.

3.10 Data Management

All data collected from the study data tool was uploaded into a password protected excel sheet and stored using non-identifiers so as to maintain confidentiality.

The data was compiled, cross-checked and rectified. The data collection tools were kept in a lockable cabinet with access restricted to the investigator and supervisors.

3.11 Data Analysis

Data was checked for completeness and free from error prior to entry and analyzed with the use of Statistical Package for Social Sciences version 24. The pattern of presentation and the perioperative management data that are categorical were analyzed and presented as frequencies and percentages, and those that are continuous were analyzed and presented as means with standard deviation or as median with interquartile range.

The factors influencing the outcome of small intestinal atresia were analyzed with the use of Pearson Chi-square tests, and factors found to be significant associations were subject to multivariate analysis with the use of logistic regression. The odds ratio, as well as a 95% confidence interval, was calculated. All tests were considered significant where the p-value was < 0.05.

3.12 Reporting of Findings

The study was conducted in three phases: phase one entailed recruitment and data collection, followed by phase two which entailed data analysis and presentation to the hospital and the University of Nairobi.

The third phase will entail feedback to the key stakeholders. The recommendations from these feedback sessions will be incorporated into the final report before publication in peer-reviewed journals.

CHAPTER 4: RESULTS

Out of the 221 files identified by the KNH records department software,202 were retrieved. 28 files had been wrongly coded,27 cases had not been operated on,9 files had significant lack of information, 3 cases had a prior laparotomy done at a facility other than KNH and 19 files were missing and could not be traced. 135 cases, which fit the inclusion criteria were studied and relevant information captured.

4.1: Clinical presentation of neonates with small intestinal atresia.

***Demographics**:* The study results indicate that there were 69 (51.1%) male patients, and 66 (48.9%) female patients. At the time of presentation, majority of the patients (101) were less than or equal to 7 (74.8%) days old, where the youngest patient was 1 day and the oldest was 55 days with a mean age of 7.3. 41.5% of the patients were less than 7 days old at time of surgery.

Majority of the patients 107 (79.3%) were born at 36-week gestation and above; with a birth weight of > 2000grams for 93 (68.9%) of the patients, the average weight was 2490grams. However, there was a reduction in the number of patients presenting with a weight of above 2000grams at time of presentation which included 68 patients (50.4%) whereas 49 patients (36.3%) had a weight range of 1501-2000 grams. The age of the mother was not specified in 55.6% (75 patients), though in 34.1% the age was between 21 and 30 years. (Table 1.1-1.7)

Table 1.1: Characteristics of the patients

Gender	Frequency(n=135)	Percentage
Male	69	51.1
Female	66	48.9

Table 1.2 (Mean (SD) = 7.3 (8.5), Median (IQR) = 5.0 (3.0 – 7.5), Min=1, Max=55)

Age at presentation (days)	Frequency (n=135)	Percentage
≤ 7	101	74.8
8-14	18	13.3
15-21	9	6.7
22-29	3	2.2
≥30	4	3.0

Table 1.3 Age at surgery (in days)	Frequency (n=135)	Percentage
≤ 7	56	41.5
8-14	45	33.3
15-21	20	14.8
22-29	5	3.7
≥30	9	6.7

Table 1.4 (Mean (SD) = 2490.4 (631.1), Median (IQR) = 2400.0 (2000.0 – 3000.0), Min=820, Max=3800)

Birth weight	Frequency(n=135)	Percentage
<1000	1	0.7
1001-1500	6	4.4
1501-2000	35	25.9
2000+	93	68.9

Table 1.5 Weight at admission (Mean (SD) = 2244.1 (732.7), Median (IQR) = 2010.0 (1775.0 – 2715.0), Min=1040, Max=6800)		
1001-1500	18	13.3
1501-2000	49	36.3
2000+	68	50.4

Table 1.6 Gestation at time of birth (Mean (SD) = 36.2 (2.0), Median (IQR) = 37.0 (36.0 – 37.5), Min=28, Max=39)		
Gestation	**frequency(n=135)**	**percentage**
28 – 31	5	3.7
32 – 35	23	17.0
36+	107	79.3

Table 1.7 Age of mother (Mean (SD) = 26.2 (5.1), Median (IQR) = 26.0 (23.0 – 28.5), Min=15, Max=41)		
Age	**Frequency(n=135)**	**percentage(%)**
≤20	7	5.2
21 – 25	20	14.8
26 – 30	26	19.3
31 – 35	4	3.0
36+	3	2.2
Not specified	75	55.6

Clinical presentation:

The most common presentation was vomiting with 96% (130 patients) having bilious vomiting and 3 patients had non bilious vomiting. 63(46.7%) patients presented with abdominal distension whereas 64 (47.4%) patients had passed scanty meconium. 36 patients (26.7%) had jaundice at the time of presentation (Figure 1 and 2)

Only 36 (26.7%) patients had an antenatal ultrasound done, of which 11 (8.1%) patients had a positive diagnosis made prenatally. (Figure 3)

83% of the patients did not have an associated anomaly, with 10.4% (14 patients) having gastrointestinal anomalies such as gastroschisis. Other anomalies involved the Cardiovascular system and syndromic patients whereby each had a frequency of 2.2%. (Table 1.8)

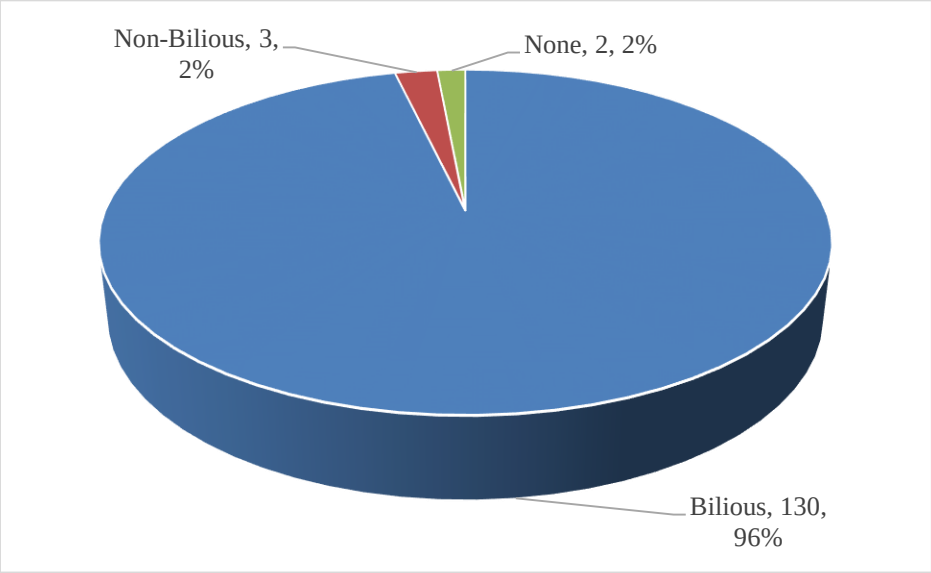


Figure 1.0: Clinical Presentation: Vomiting

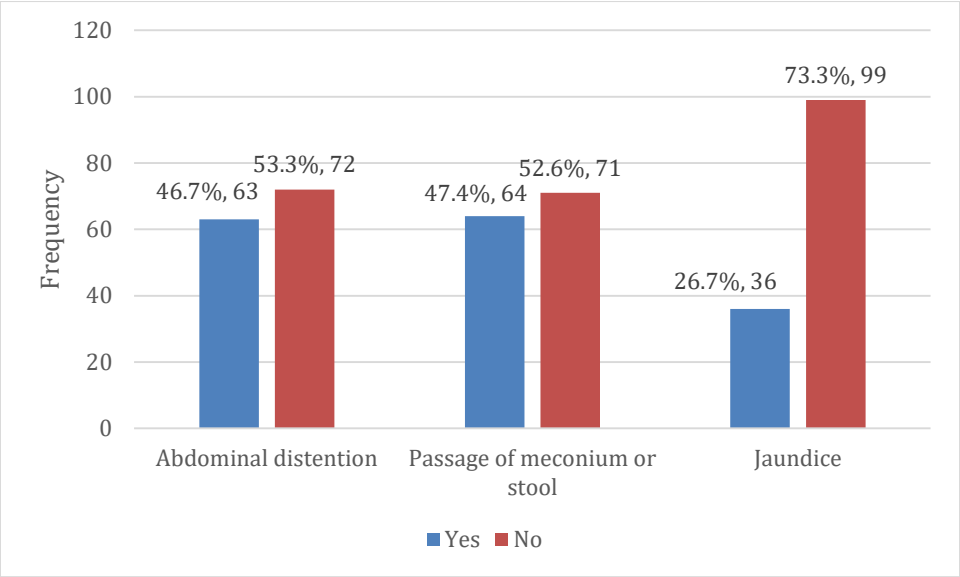


Figure 2.0 Clinical presentation

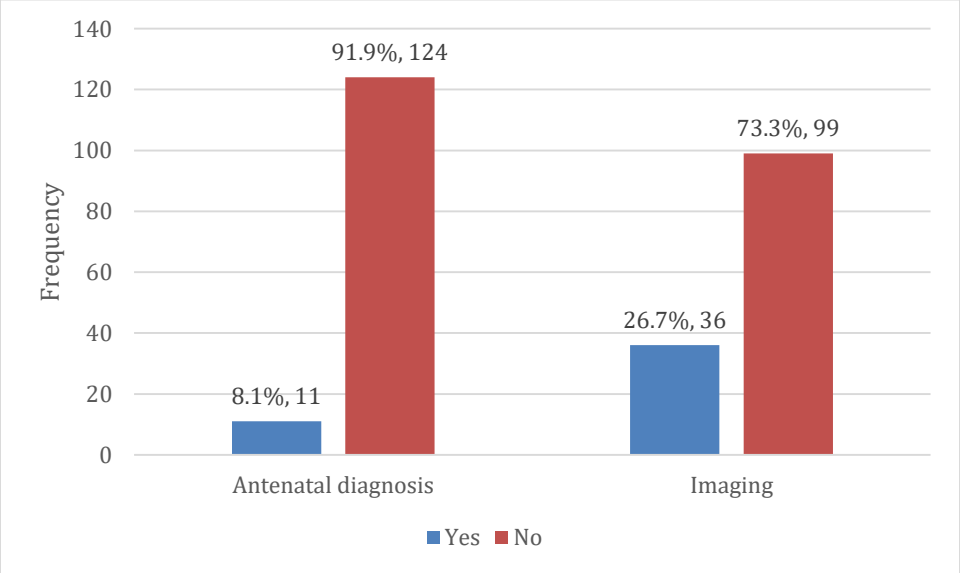


Figure 3.0: Antenatal diagnosis and imaging

Table 1.8: Associated anomalies

	Frequency (n=135)	Percentage
CVS	3	2.2
Anterior abdominal wall defects	2	1.5
GIT	14	10.4
MSS-CTEV	1	0.7
Syndromic	3	2.2
None	112	83.0

Characteristics of the atresia:

The most common type of atresia is Type I, in both duodenal (28%) and Jejunoileal atresia (42%). Type II atresia was the least common having none reported in duodenal atresia and 4 noted in Jejunoileal atresia. (Figure 4)

The frequency of the location of the atresia at the jejunum, ileum and duodenum was 82(60.7%),14(10.4%) and 39 (28.9%) respectively. Majority of the Jejunoileal atresia (45.8%) occurred between 11 and 20 cm from the duodenojejunal junction (DJ) and 26% occurred less than 10 cm from the DJ (Table 1.9 and 2.0)

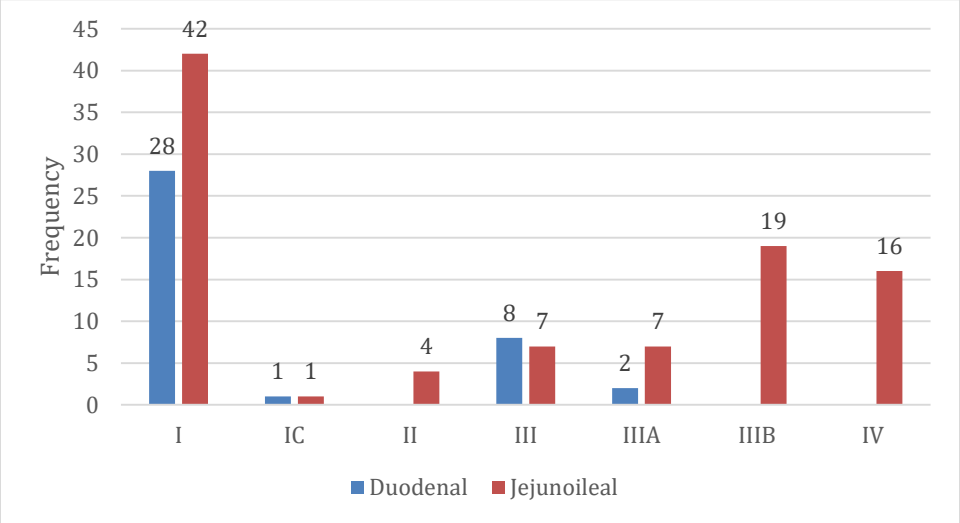


Figure 4.0: Atresia type

Table 1.9: Location of atresia

	Frequency (n=135)	Percentage
Duodenal	39	28.9
Ileal	14	10.4

Table 2.0	**Frequency (n=96)**	**Percentage**
Distance of atresia from DJ(in cm)		
<10	25	26.0
11 – 20	44	45.8
21 – 30	13	13.5
31 – 40	2	2.1
41 – 50	6	6.3

4.2: Perioperative management of neonates with small intestinal atresia

Surgical management:

Resection of gut is not applicable for duodenal atresia thus all 39 patients with DA did not undergo the procedure. Majority of the patients with JIA did not have either the proximal 38(28.1%) or the distal gut 58(43%) resected though applicable as a surgical procedure. Of those who had resection done,18.5% had a range of 6-10 cm of proximal gut resection whereas 24% had <5cm resection of the distal gut (Table 3.1 and 3.2)

Tapering of the proximal gut was performed in 51 patients (37.8%) and a temporary stoma was fashioned in 2 of the cases. The most common surgical procedure was primary anastomosis accounting for 130 cases (96.3%). In three of the patients, surgery was abandoned due to short bowel length incompatible with life (Table 3.3-3.5)

Table 3.1

Length resected(in cm)-proximal gut	Frequency(n=135)	Percentage%
N/A	39	28.9
<5	24	17.8
6-10	25	18.5
11-15	5	3.7
16-20	3	2.2
>20	1	0.7
Not resected	38	28.1

Table 3.2

Length resected (in cm)-distal gut	frequency(n=135)	Percentage%
N/A	39	28.9
≤5	33	24.4
6-10	3	2.2
11-15	2	1.5
Not resected	58	43.0

Table 3.3 Tapering	Frequency (n=135)	Percentage
Yes	51	37.8

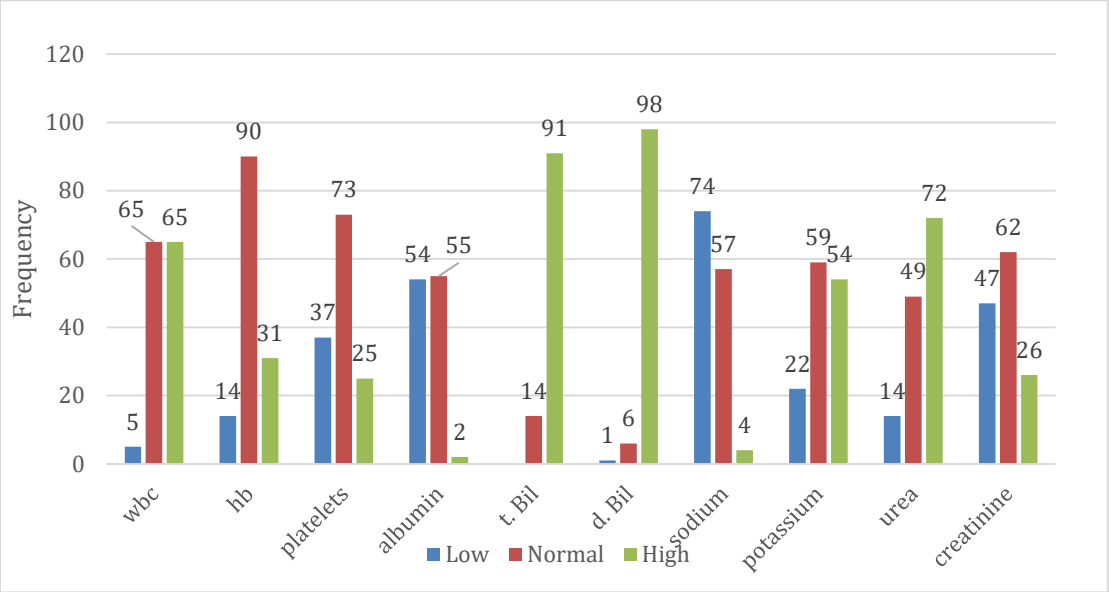
Table 3.4 Primary anastomosis	Frequency(n=135)	Percentage%
Yes	130	96.3
No	5	3.7

Table 3.5 Stoma fashioning	Frequency(N=135)	Percentage%
Yes	2	1.5
No	133	98.5

Labarotory investigation:

Preoperative values were evaluated for all of the patients.(figure 5). Majority of the patients had lymphocytosis (95) or lymphopenia(5) and hyperbilirubinemia in more than 90 patients. The hemoglobin level was above 12g/dl in most of the patients at start of surgery. Electrolyte derangements of both sodium and potassium were noted in more than half of the patients.Urea was elevated above normal range in 72 out of 135 patients.

Figure 5: Preoperative investigations.



Postoperative management:

95.6% (129) of the patients were not admitted to the Neonatal ICU. 35.6% of the patients had a central venous catheter fixed and started on Total Parenteral Nutrition. Majority of the patients (13.35) used TPN for an average of less than 10 days and 10.4% were on TPN for a duration of between 11 and 20 days. 7 patients had prolonged used of TPN for more than a month (Table 3.6 and 3.7)

In 23% of the patients, enteral feeds were not reintroduced postoperatively. The average time for introduction of enteral feeds was between day 1 and 5 for 34.1 % of the patients followed by day 6-10 in 26.7% (36 patients) with earlier introduction in patients with duodenal atresia. (table 3.8 and 3.9)

Table 3.6 Admission to neonatal ICU	**Frequency(n=135)**	**Percentage(%)**
Yes	6	4.4
No	129	95.6
Tale 3.7 Use of total parenteral nutrition		
Yes	48	35.6
No	87	64.4
Table 3.8 Duration of use of TPN		
Not on TPN	87	64.4
≤10	18	13.3
11-20	14	10.4
21-30	9	6.7
>30	7	5.2
Table 3.9 Reintroduction of enteral feeds postoperatively		
Did not introduce feeds	31	23.0
<5	46	34.1
5-10	36	26.7
11-15	17	12.6
>15	5	3.7

4.3: Surgical outcomes of small intestinal atresia

37% of the patients did not have any complications. The most common complication was anemia accounting for 35.6% of the patients, followed by jaundice and sepsis at 17.8% and 17% respectively. 4 of the patients developed an anastomotic leak and 2 patients had reoperations done. Local wound complications occurred in 14 of the patient with resolution of symptoms after treatment. (Table 4.0)

67 patients (49.6%) did not attain full enteral feeds during their stay in hospital. 14.8% of patients reached full enteral feeds between day 5 and 10, whereas 11.9 % reached full feeds between day 11 and 15. Patients with duodenal atresia reached full feeds earlier than JIA patients (Table 4.1,4.2)

Majority of patients' (25.9%) duration of hospital stay was 3 weeks followed by 16.3% at 5-week duration. Mortality was at 56.3% of the total number of patients. (Table 4.3,4.4)

Table 4.0: Complications

	Frequency	**Percent of cases (n=135)**
None	50	37.0
Anaemia	48	35.6
Abscess	1	0.7
Aspiration	2	1.5
CVC dislodged	1	0.7
Feeding intolerance	4	3.0
Jaundice	24	17.8
Sepsis	23	17.0
Anastomotic leak	4	3.0
Bleeding	1	0.7
GIB	2	1.5

AKI	1	0.7
Met acidosis	2	1.5
SSI	5	3.7
Wound dehiscence	8	5.9
Reoperation	2	1.5
Abdominal distention	1	0.7
Stoma complications	1	0.7
Perforation	1	0.7
SBS	2	1.4
CVC complications	2	1.5

Table 4.1:

Duration to full enteral feeds (in days)	**Frequency (n=135)**	**Percentage**
Did not attain full feeds	67	49.6
<5	5	3.7
5-10	20	14.8
11-15	16	11.9
16-20	7	5.2
21-25	10	7.4
26+	10	7.4

Table 4.2: Length of hospital stay (in days)	Frequency(n=135)	Percentage(%)
≤ 7	9	6.7
8-14	24	17.8
15-21	35	25.9
22-29	20	14.8
30-36	22	16.3
37-43	14	10.4
44+	11	8.1
Table 43 Mortality		
Yes	76	56.3
No	59	43.7

4.4: Factors influencing the surgical outcome of neonates with small intestinal atresia:

The above factors which include the patients' clinical presentation and the perioperative management were analyzed against the outcome of mortality to determine any statistical significance.

Age at presentation, age at surgery, birth weight, weight at admission, weight loss at time of admission, and gestation at time of birth do not affect the odds of the outcome of mortality. (OR=1)

Patients that had abdominal distention were 1.4 times more likely to have an unfavorable outcome than those without, but this was not statistically significant. Patients passing meconium or stool were less likely to have mortality as an outcome but this also did not have statistical significance. A jaundiced patient had 1.3 times the odds of mortality, though this was also not statistically significant. Antenatal diagnosis had 1.4 times odds of mortality (CI (0.39 – 5.01)) however, this was not statistically significant; p-value-0.61.

Neonates with associated anomalies were found to have an odds ratio of 23.6 (CI 3.08 – 181.4) and this was a statistically significant factor with a p-value of **0.006.**

Type III atresia was a significant factor of mortality with a p value of **0.007**

Patients who did not have enteral feeds introduced postoperatively were at risk of mortality (p value 0.002) however, duration taken to full feeds was not a factor associated with mortality.

The location of atresia, surgical technique used, length of resected gut and admission to NICU were not found to be significant risks of mortality. Use of TPN was a statistically significant factor of mortality with an odds ratio of 3.19 (confidence interval of 1.49-6.83) and p-value of **0.003**

Patients with sepsis were more likely (1.25 times) to succumb however it was not statistically significant. Length of hospital stay was not associated with the odds of mortality.

Factors influencing the outcome of small intestinal atresia at KNH

i) Patient factors and perioperative management factors which influence the mortality of the patients.

	Mortality			
	Yes	**No**	**OR (95% CI)**	**p-value**
Age at presentation (days), *mean (SD*	7.3 (8.4)	7.4 (8.8)	1.00 (0.96 – 1.03)	0.906
Age at surgery (days), *mean (SD)*	11.8 (9.7)	17.3 (47.0)	1.00 (0.97 – 1.01)	0.406
Birth weight, *mean (SD)*	2433.3 (625.7)	2564.0 (635.6)	1.00 (0.99 – 1.00)	0.233
Weight at admission, *mean (SD)*	2165.5 (613.1)	2345.3 (857.8)	1.00 (0.99 – 1.00)	0.166
Weight loss at time of admission (difference between birth weight and weight at admission), *mean (SD)*	267.8 (204.5)	218.6 (605.1)	1.00 (0.99 – 1.00)	0.520
Gestation at time of birth, *mean (SD)*	36.2 (2.0)	36.3 (2.0)	0.99 (0.83 – 1.17)	0.891

	Mortality			
	yes	**no**	**OR(95% CI)**	**P value**
Vomiting, *n (%)*				
Bilious	73 (96.1)	57 (96.6)	0.9 (0.1 – 5.3)	0.865
Non-Bilious/None	3 (3.9)	2 (3.4)	Reference	
Abdominal distention, *n (%)*				
Yes	38 (50.0)	25 (42.4)	1.36 (0.69 – 2.70)	0.379
No	38 (50.0)	34 (57.6)	Reference	
	Yes	**No**	**OR(95% CI)**	**P value**
Passage of meconium or stool, *n (%)*				
Yes	32 (42.1)	32 (54.2)	0.61 (0.31 – 1.22)	0.163
No	44 (57.9)	27 (45.8)	Reference	
Jaundice, *n (%)*				
Yes	22 (28.9)	14 (23.7)	1.31 (0.60 – 2.85)	0.497
No	54 (71.1)	45 (76.3)		
Antenatal diagnosis, *n (%)*				
Yes	7 (9.2)	4 (6.8)	1.40 (0.39 – 5.01)	0.610
No	69 (90.8)	55 (93.2)	Reference	
Associated Anomalies, *n (%)*				
Yes	22 (28.9)	1 (1.7)	23.6 (3.08 – 181.4)	**0.002**
No	54 (71.1)	58 (98.3)	Reference	
Location of atresia, *n (%)*				
Duodenal	18 (23.7)	21 (35.6)	0.56 (0.27 – 1.19)	0.132
Jejonoileal	58 (76.3)	38 (64.4)	Reference	

	Mortality			
Type of atresia, *n (%)*	**Yes**	**No**	**OR (95% CI)**	**p-value**
I	28 (36.8)	44 (74.6)	0.6 (0.2 – 1.9)	0.416
II	3 (3.9)	1 (1.7)	3.0 (0.3 – 35.3)	0.383
III	22 (28.9)	2 (3.4)	11.0 (1.9 – 63.2)	**0.007**
IIIB	15 (19.7)	4 (6.8)	3.8 (0.9 – 16.4)	0.079
IV	8 (10.5)	8 (13.6)	Reference	

Surgical technique used	**Mortality**			
Length of gut resected (proximal), *n (%)*	**Yes**	**No**	**OR (95% CI)**	**p-value**
≤5	16 (27.6)	9 (23.7)	Reference	
6-10	11 (19)	13 (34.2)	0.5 (0.2 – 1.5)	0.204
11-15	3 (5.2)	2 (5.3)	0.8 (0.1 – 6.0)	0.866
>15	2 (3.4)	2 (5.3)	0.6 (0.1 – 4.7)	0.595
Not resected	26 (44.8)	12 (31.6)	1.2 (0.4 – 3.5)	0.716
Length of gut resected (distal), *n (%)*				
≤5	17 (29.3)	16 (42.1)		
6-10	3 (5.2)	0 (0.0)	-	
11-15	2 (3.4)	0 (0.0)	-	
Not resected	36 (62.1)	22 (57.9)		
Tapering				
Yes	30 (39.5)	21 (35.6)	1.18 (0.58 – 2.39)	0.645
No	46 (60.5)	38 (64.4)	Reference	

Primary anastomosis				
Yes	71 (93.4)	59 (100.0)	-	0.068
No	5 (6.6)	0 (0.0)		
Stoma fashioning				
Yes	2 (2.6)	0 (0.0)	-	0.504
No	74 (97.4)	59 (100.0)		
		Mortality		
Admission to NICU, *n (%)*	**Yes**	**No**	**OR (95% CI)**	**p-value**
Yes	5 (6.6)	1 (1.7)	4.09 (0.46 – 35.94)	0.205
No	71 (93.4)	58 (98.3)	Reference	
Use of TPN, *n (%)*				
Yes	36 (47.4)	13 (22.0)	3.19 (1.49 – 6.83)	**0.003**
No	40 (52.6)	46 (78.0)	Reference	
Reintroduction of enteral feeds				
Did not introduce	30 (39.5)	1 (1.7)	30.0 (3.5 – 260.3)	**0.002**
≤ 5	16 (21.1)	30 (50.8)	0.5 (0.2 – 1.5)	0.233
5 – 10	19 (25.0)	17 (28.8)	1.1 (0.4 – 3.2)	0.837
>10	11 (14.5)	11 (18.6)	Reference	
Duration to full enteral feeds, *n (%)*				
Did not introduce	67 (88.2)	0 (0.0)		
≤10	5 (6.6)	20 (33.9)	2.4 (0.6 – 10.1)	0.219
>10	4 (5.3)	39 (66.1)	Reference	

Complications, *n (%)*	**Yes**	**No**	**OR(95% CI)**	**p-value**
Anaemia				
Yes	25 (32.9)	22 (37.3)	0.82 (0.40 – 1.68)	0.595
No	51 (67.1)	37 (62.7)	Reference	
Jaundice				
Yes	10 (13.2)	13 (22.0)	0.54 (0.22 – 1.33)	0.178
No	66 (86.8)	46 (78.0)	Reference	
Sepsis				
Yes	14 (18.4)	9 (15.3)	1.25 (0.50 – 3.14)	0.628
No	62 (81.6)	50 (84.6)	Reference	
Length of Hospital stay, *mean (SD)*	22.6 (12.7)	26.5 (13.2)	0.98 (0.95 – 1.00)	0.085

ii**). Bivariate analysis of factors of presentation and perioperative management to the duration to achieve full feeds.**

There were significant differences noted with age at surgery, associated anomalies, location of atresia, type of surgical technique, use of TPN and the complications encountered when analyzed against the duration taken to get to full enteral feeds.

Duration to full feeds	**Did not achieve**	**≤10**	**>10**	**p-value**
Age at surgery, *mean (SD)*	11.9 (0.7)	28.8 (71.1)	9.4 (6.7)	**0.036**
Associated anomalies, *n (%)*	Did not achieve	**≤10**	**>10**	**p-value**
Yes	19 (28.4)	2 (8.0)	2 (4.7)	**0.002**
No	48 (71.6)	23 (92.0)	41 (95.3)	
Location of atresia, *n (%)*				
Duodenal	15 (22.4)	14 (56.0)	10 (23.3)	**0.004**
Jejunoileal	52 (77.6)	11 (44.0)	33 (76.7)	

Tapering, *n (%)*	**Did not achieve**	**<10**	**>10**	**P value**
Yes	27 (40.3)	4 (16.0)	20 (46.5)	**0.037**
No	40 (59.7)	21 (84.0)	23 (53.5)	
Primary anastomosis, *n (%)*				
Yes	64 (95.5)	23 (92.0)	43 (100.0)	0.217
No	3 (4.5)	2 (8.0)	0 (0.0)	
Stoma fashioning, *n (%)*				
Yes	0 (0.0)	2 (8.0)	0 (0.0)	**0.011**
No	67 (100.0)	23 (92.0)	43 (100.0)	
Admission to NICU, *n (%)*				
Yes	5 (7.5)	0 (0.0)	1 (2.3)	0.217
No	62 (92.5)	25 (100.0)	42 (97.7)	
Use of TPN, *n (%)*				
Yes	33 (49.3)	1 (4)	15 (34.9)	**<0.001**
No	34 (50.7)	24 (96)	28 (65.1)	
Complications : Anemia, *n (%)*				
Yes	20 (29.9)	5 (20.0)	22 (51.2)	**0.016**
No	47 (70.1)	20 (80.0)	21 (48.8)	
Sepsis, *n (%)*				
Yes	13 (19.4)	2 (8.0)	8 (18.6)	0.410
No	54 (80.6)	23 (92.0)	35 (81.4)	
Jaundice, *n (%)*				
Yes	9 (13.4)	0 (0)	14 (32.6)	**0.001**
No	58 (86.6)	25 (100)	29 (67.4)	

iii). **Bivariate analysis of the clinical presentation and perioperative management with the length of hospital stay**.

Complications such as anemia and jaundice were significant factors that influenced the length of stay of the patients.

Length of hospital stay (days)	**≤14**	**15-28**	**>28**	**p-value**
Associated anomalies, *n (%)*				
Yes	9 (27.3)	6 (11.1)	8 (16.7)	0.150
No	24 (72.7)	48 (88.9)	40 (83.3)	
Location of atresia, *n (%)*				
Duodenal	11 (33.3)	16 (29.6)	12 (25)	0.638
Ileal	4 (12.1)	7 (13)	3 (6.3)	
Jejunal	18 (54.5)	31 (57.4)	33 (68.8)	
Tapering, *n (%)*				
Yes	11 (33.3)	17 (31.5)	23 (47.9)	0.193
No	22 (66.7)	37 (68.5)	25 (52.1)	
Primary anastomosis, *n (%)*				
Yes	32 (97.0)	52 (96.3)	46 (95.8)	0.965
No	1 (3.0)	2 (3.7)	2 (4.2)	
Stoma fashioning, *n (%)*				
Yes	0 (0.0)	0 (0.0)	2 (4.2)	0.159
No	33 (100.0)	54 (100.0)	46 (95.8)	
Admission to NICU, *n (%)*				
Yes	3 (9.1)	0 (0.0)	3 (6.3)	0.102
No	30 (90.9)	54 (100.0)	45 (93.8)	

Use of TPN, *n (%)*	**<14**	**15-28**	**>28**	**P=value**
Yes	9 (27.3)	21 (38.9)	19 (39.6)	0.462
No	24 (72.7)	33 (61.1)	29 (60.4)	
Complications				
Anaemia, *n (%)*				
Yes	8 (24.2)	13 (24.1)	26 (54.2)	**0.002**
No	25 (75.8)	41 (75.9)	22 (45.8)	
Jaundice, ***n (%)***				
Yes	2 (6.1)	4 (7.4)	17 (35.4)	**<0.001**
No	31 (93.9)	50 (92.6)	31 (64.6)	
Sepsis, ***n (%)***				
Yes	3 (9.1)	9 (16.7)	11 (22.9)	0.265
No	30 (90.9)	45 (83.3)	37 (77.1)	

CHAPTER 5: DISCUSSION

The survival rate of SIA has since improved over the years in the developed countries yet that of developing countries is still low with a mortality rate of up to 50%. Several studies have been able to identify factors that have led to improved survival of these patients in the developed countries. These factors are available at KNH, however, in comparison to the developed countries, our mortality rate is high. This study was aimed at determining the factors that influence the surgical outcome of SIA at KNH which we have been able to infer with the above results.

In our study at KNH, the gestational age and birth weight did not show any statistical difference when analyzed against mortality as the outcome. These findings were similar to a study done by Piper et al where they found no statistical difference with the gestational age and birth weight correlating to mortality. However, Ameh et al in a study done in Nigeria found that prematurity was a significant factor of mortality. Birth weight of less than 2000grams was identified as an independent risk factor for both mortality and prolonged hospital stay (11) which was contrary to our study as most of our patients were more than 2000grams.

Late presentation of the neonates has been identified as a factor of poor outcomes of neonates with SIA, where the average age at presentation was 6 days in a study done by Ameh et al, similarly, majority of our patients presented at 7 days of life or earlier. The symptomatology of the neonates did not show any statistical significance in our study and it has not been proposed as a factor of mortality by other studies.

Antenatal diagnosis was not significant but was associated with 1.4 times the odds of mortality. It has been identified as a factor of improved survival of patients as treatment is initiated early avoiding the complications associated with late presentation and delayed diagnosis (2)

Presence of associated anomalies was a statistically significant factor of mortality with a p value of <0.006. The findings echo the results of Best et al which found associated anomalies to be an independent risk factor for mortality in patients with SIA. Piper et al noted that patients with duodenal atresia were more likely to have associated anomalies compared to JIA neonates (P value 0.001) and that the presence of associated anomalies increased the mortality risk. In these patients, associated anomalies and low birth weight were conditionally dependent on each other where the risk of mortality increased further when the birth weight was less than 2000 grams (11). Most of our recorded anomalies were in the GIT system such as gastroschisis and short bowel which may have attributed to the prolonged the duration to reach

full feeds. Patients with associated anomalies were associated with a longer hospital stay (31 days Vs 18 days) (11) however this was not observed in our study.

The location of the atresia was not found to be a significant risk factor of both mortality and duration of hospital stay, however, there were differences noted with duration taken to achieve full feeds.

These findings were similar to a study done by Best et al where neonates with jejunal atresia took longer to achieve full feeds but no differences were noted between location of atresia and mortality or length of hospital stay. Patients with JIA took longer to reach full feeds compared to those with DA (17).

Type III atresia was found to be a significant risk of mortality in our study with a p value of 0.007. Similarly, severe types of JIA, Type IIIB and type IV, were associated with a higher rate of mortality compared to the other types of atresia (15)

The surgical technique used in management of SIA neither affected the odds of mortality significantly nor the length of hospital stay. Primary anastomosis was found to reduce the morbidity and mortality in all types of JIA (23). It is the most common technique used in our facility and the complications arising directly from the technical aspects of the surgery were few thus the expertise in the surgery has not been found to negatively influence the outcome. In neonates with proximal atresia, tapering was found to facilitate early establishment of enteral feeds and decrease the duration of hospital stay (27).

Admission to the neonatal ICU was not a statistically significant factor of mortality. NICU admission was one of the factors that has aided in the improvement of survival of SIA patients from 50% to 11% (5,33). In our set up, the resource is constrained as 8 beds cater for all the neonates seen at KNH thus even the patients that may require the service may not receive it.

Use of TPN was noted to be a significant factor of mortality in our study. TPN was a significant factor in improving the survival of SIA neonates especially those with short bowel and are dependent on TPN for longer periods prolonging the length of hospital stay. (5,32). Increase in use of TPN over the time period of 1976-1998 led to marked improvement in survival of the patients managed at a Pediatric Surgical Centre at the United Kingdom with an overall survival of 90%(36). Several studies in sub-Saharan Africa have attributed high rate of mortality to lack of TPN at their facilities. Majority of our patients (64.4%) were not on TPN which was attributed to lack of CVC insertion due to lack of availability of the catheters.

In the recent years, provision of the CVC by the hospital has led to a greater number of patients receiving TPN.

The complications developed did not correlate with the outcome of mortality, however, anemia and postoperative jaundice were significant in the duration taken to achieve full enteral feeds and in the length of hospital stay. Development of postoperative complications were noted to increase length of hospital stay (11). Sepsis was noted as the leading cause of mortality in SIA (15), though our finding noted sepsis as a common complication, it was not a significant risk for mortality.

5.1 STUDY LIMITATIONS

There were 19 missing files from the KNH records department and 28 files were wrongly coded.

Of the files obtained, that fit the inclusion criteria, there was missing information especially that of age of mother and the postoperative laboratory investigations.

5.2 RECOMMENDATIONS

1. Dissemination of information to the peripheral health facilities concerning: the antenatal diagnosis via imaging, symptoms, diagnosis and initial stabilization of neonates with SIA prior to transfer to a specialized facility.
2. Adequate preoperative management followed by timely and sequential postoperative laboratory work up so as to identify and treat complications that may arise.
3. Central Venous Catheter insertion at time of surgery with early initiation of TPN.
4. Increase capacity of the Neonatal ICU at KNH and have a low threshold for admission of SIA patients.

5.3 CONCLUSION

Small intestinal atresia is a common disease seen at KNH. The mortality of patients with SIA at KNH is at 56.3% compared to 5-10% in developed countries. Significant factors noted to be contributing to the mortality are presence of associated anomalies, type of atresia and use of TPN. There is availability of resources such as neonatal ICU and TPN at KNH, which may aid in improving the survival of these patients. These factors though available, are few and strained to meet the needs of all our patients. Capacity building and incorporation of a perioperative management protocol would aid in improving the outcomes of our patients.

6.0 Study Timelines

ACTIVITY	NOV-DEC 2020	JAN 2021	FEB-MAR 2021	APRIL 2021	MAY 2021	JUNE 2021
Proposal development						
Department approval						
Ethical Approval						
Data collection						
Data Analysis						
Dissertation writing and Submission						

REFERENCES

1. Lupo PJ, Isenburg JL, Salemi JL, Mai CT, Liberman RF, Canfield MA, et al. Population-based birth defects data in the United States, 2010–2014: A focus on gastrointestinal defects. Birth Defects Res 2017 Nov 1 [cited 2020 Dec 1];109(18):1504–14.

2. Dalla Vecchia LK, Grosfeld JL, West KW, Rescorla FJ, Scherer LR, Engum SA. Intestinal atresia and stenosis: A 25-year experience with 277 cases. Arch Surg. 1998 May;133(5):490–7.

3. Sholadoye TT, Mshelbwala PM, Ameh EA. Presentation and outcome of treatment of jejunoileal atresia in Nigeria. African J Paediatr Surg. 2018 Apr 1 [cited 2020 Nov 29];15(2):84–7.

4. Osifo OD, Okolo JC. Neonatal intestinal obstruction in Benin, Nigeria. African J Paediatr Surg. 2009 Feb 1 [cited 2020 Nov 29];6(2):98–101.

5. Stollman TH, de Blaauw I, Wijnen MHWA, van der Staak FHJM, Rieu PNMA, Draaisma JMT, et al. Decreased mortality but increased morbidity in neonates with jejunoileal atresia; a study of 114 cases over a 34-year period. J Pediatr Surg. 2009 Jan [cited 2020 Nov 29];44(1):217–21.

6. Ekwunife O, Oguejiofor I, Modekwe V, Osuigwe A. Jejuno-ileal atresia: A 2-year preliminary study on presentation and outcome. Niger J Clin Pract. 2012 Jul [cited 2020 Dec 3];15(3):354.

7. Britton J, Britton H. Gastric aspirate volume at birth as an indicator of congenital intestinal obstruction. Acta Pædiatrica. 1995 [cited 2020 Dec 3];84(8):945–6.

8. Akinmoladun JA, Lawal TA, Hafiz A. LATE THIRD TRIMESTER ULTRASOUND DIAGNOSIS OF DUODENAL ATRESIA - THE IMPORTANCE OF DETAILED PRENATAL ULTRASOUND SCREENING. Ann Ibadan Postgrad Med . 2019 Jun [cited 2020 Nov 29];17(1):71–4.

9. Calisti A, Olivieri C, Coletta R, Briganti V, Oriolo L, Giannino G. Jejunoileal atresia: Factors affecting the outcome and long-term sequelae. J Clin Neonatol 2012 [cited 2020 Nov 29];1(1):38.

10. Cairo S, Kakembo N, Kisa P, Muzira A, Cheung M, Healy J, et al. Disparity in access and outcomes for emergency neonatal surgery: intestinal atresia in Kampala, Uganda. Pediatr Surg Int [. 2017 Aug 1 [cited 2020 Nov 29];33(8):907–15. Available from: https://pubmed.ncbi.nlm.nih.gov/28677072/

11. Piper HG, Alesbury J, Waterford SD, Zurakowski D, Jaksic T. Intestinal atresias: factors affecting clinical outcomes. J Pediatr Surg. 2008 Jul;43(7):1244–8.

12. Chirdan LB, Uba AF, Pam SD. Intestinal atresia: Management problems in a developing country. Pediatr Surg Int. 2004 Dec;20(11–12):834–7.

13. Juang, D., & Snyder, C. (2012). Neonatal bowel obstruction. The Surgical clinics of North America, 92 3, 685-711, ix-x.

14. Huebner, Benjamin & Azarow, Kenneth & Cusick, Robert. (2013). Intestinal atresia due to intrauterine intussusception of a Meckel's diverticulum. Journal of Pediatric Surgery Case Reports. 1. 232-234. 10.1016/j.epsc.2013.07.005.

.

15. Shakya VC, Agrawal CS, Shrestha P, Poudel P, Khaniya S, Adhikary S. Management of jejunoileal atresias: An experience at eastern Nepal. BMC Surg. 2010 Dec 26 [cited 2020 Nov 30];10(1):35.

16. Forrester MB, Merz RD. Population-based study of small intestinal atresia and stenosis, Hawaii, 1986-2000. Public Health 2004 Sep [cited 2020 Dec 3];118(6):434–8.

17. Best KE, Tennant PWG, Addor MC, Bianchi F, Boyd P, Calzolari E, et al. Epidemiology of small intestinal atresia in Europe: A register-based study. Arch Dis Child Fetal Neonatal Ed . 2012 Sep 29 [cited 2020 Nov 29];97(5):F353

18. Mirza B, Ijaz L, Saleem M, Sheikh A. Multiple associated anomalies in a single patient of duodenal atresia: a case report. Cases J. 2008 Dec [cited 2020 Dec 3];1(1):215.

19. Piper HG, Alesbury J, Waterford SD, Zurakowski D, Jaksic T. Intestinal atresias: factors affecting clinical outcomes. J Pediatr Surg 2008 Jul [cited 2020 Nov 29];43(7):1244–8.

20. Brindle, M.E., McDiarmid, C., Short, K. et al. Consensus Guidelines for perioperative Care in Neonatal Intestinal Surgery: Enhanced Recovery After Surgery (ERAS®) Society Recommendations. World J Surg 44, 2482–2492 (2020). https://doi.org/10.1007/s00268-020-05530-1

21. Osifo OD, Okolo CJ. Management of intestinal atresia: Challenges and outcomes in a resource-scarce region. Surg Pract. 2009;13(2):36–41.

22. Gupta S, Gupta R, Ghosh S, Gupta AK, Shukla A, Chaturvedi V, et al. Intestinal Atresia: Experience at a Busy Center of North-West India. J Neonatal Surg. 2016 Oct 7 [cited 2020 Nov 30];5(4):51.

23. Shahjahan M, Ferdous KMN, Mitul MAR, Islam MK. Management of Jejunoileal Atresia : Our 5 year Experience. Chattagram Maa-O-Shishu Hosp Med Coll J. 2013 Oct 28;12(3):52–5.

24. Peng YF, Zheng HQ, Zhang H, He QM, Wang Z, Zhong W, et al. Comparison of outcomes following three surgical techniques for patients with severe jejunoileal atresia. Gastroenterol Rep. 2019 Dec 1 [cited 2020 Dec 2];7(6):444–8.

25. Pandey A, Singh A, Agarwal P, Gupta A, Rawat J, Kureel SN. A Pilot Study on Histopathology of the Jejunoileal Atresia-Can it Be Used as a Guide to Determine the Length of Adequate Resection? Clin Pathol (Thousand Oaks, Ventur County, Calif). 2019 [cited 2020 Nov 25];12:2632010X19829263.

26. Tander B, Bicakci U, Sullu Y, Rizalar R, Ariturk E, Bernay F, et al. Alterations of Cajal cells in patients with small bowel atresia. J Pediatr Surg. 2010 Apr [cited 2020 Nov 30];45(4):724–8

.

27. Marei MM, Abouelfadl MH, Rawwash AAE, Seleim HM, Mahmoud WM, Yassin TYM, et al. Early outcomes of tapering jejunoplasty by antimesenteric seromuscular stripping and mucosal inversion for proximal jejunal atresia. Egypt Pediatr Assoc Gaz 2019 Dec 9 [cited 2020 Nov 30];67(1):1–7

28. Ameh E, Suleiman A, Sholadoye T, Mshelbwala P. Early oral feeding following intestinal anastomoses in children is safe. African J Paediatr Surg [Internet]. 2012 May [cited 2021 Jan 11];9(2):113.

29. Wang J, Du L, Cai W, Pan W, Yan W. Prolonged feeding difficulties after surgical correction of intestinal atresia: A 13-year experience. J Pediatr Surg. 2014 Nov 1;49(11):1593–7.

30. Sholadoye TT, Mshelbwala PM, Ameh EA. Presentation and outcome of treatment of jejunoileal atresia in Nigeria. African J Paediatr Surg . 2018 Apr 1 [cited 2020 Dec 2];15(2):84–7.

31. Pereira-da-Silva, Luis & Pissarra, Susana & Alexandrino, Ana & Malheiro. Guidelines for Neonatal Parenteral Nutrition: 2019 Update by the Portuguese Neonatal Society. Part II. Micronutrients, Ready-to-use Solutions and Particular Conditions. 10.25754/pjp.2019.16027.

32. Chadha R, Sharma A, Roychoudhury S, Bagga D. Treatment strategies in the management of jejunoileal and colonic atresia. J Indian Assoc Pediatr Surg [Internet]. 2006 Apr 1 [cited 2021 Jan 11];11(2):79.

33. Glass, Nina E et al. “The surgical apgar score predicts postoperative ICU admission.” Journal of gastrointestinal surgery : official journal of the Society for Surgery of the Alimentary Tract vol. 19,3 (2015): 445-50. doi:10.1007/s11605-014-2733-8.

34. Barrack SM, Kyambi JM. Intestinal atresia and stenosis as seen and treated at Kenyatta National Hospital, Nairobi. East Afr Med J.1993 Sep;70(9):558-64

35. Nusinovich Y, Revenidas M. Long-term outcomes for infants with intestinal atresia studied at Children’s National Center. J Pediatr Gastroenterol Nutri. 2013 Sep;57(3):324-9

36. Kumaran N, Shankar KR, Lloyd DA, Losty PD. Trends in the management and outcome of jejuno-ileal atresia. Eur J Pediatr Surg. 2002 Jun;12(3):163-7. doi: 10.1055/s-2002-32726. PMID: 12101497.

STUDY BUDGET

ITEM	COST (KSh.)
Research fees	5,000
Statistician	40,000
Research assistants (2) -training and data collection KSh.20000 each	40,000
Stationary • **Photocopying** -40 pages*KSh 5/page*3 copies per submission*3times • **Printing** -40 pages*ksh 10/page*3 times submission - 231 data collection forms*3 pages per form *10KSh./ page -final publication approximately 60 pages*KSh.10 /page • **Binding** - KSh. 150/book*3 copies*3 times submission to ethics • Pens, paper punch, files, writing books, envelopes • N95masks-3(researcher +assistants) * Ksh 400 each*3 for each • Sanitizers 3 researchers *KSh.600*2 each • Gloves used during data collection 3 researchers*3000 per box of gloves	Total stationery ksh. 28080 • 1800 • 6930 • 1350 • 600 • 1350 • 1200 • 3600 • 3600 • 9000
Publication	15,000
Contingencies 15% of total budget	22,500
TOTAL	**151,930**

ANNEX 1

DATA COLLECTION TOOL

Date …….

Time ……

Serial no. ……

BIODATA

Age at presentation (in days) …….

Gender …….

Birth weight (in grams) …….

Weight at admission (in grams) ……

Gestation at time of birth ……...

Age of mother ……..

CLINICAL PRESENTATION

Vomiting –bilious ☐

-non-bilious ☐

Abdominal distension ☐

Passage of meconium or stool ☐

Jaundice ☐

Antenatal diagnosis via imaging ☐

Associated anomalies

CVS-	RESP-
CNS-	MSS-
GIT-	SYNDROMIC-

Other- ……..

Type of atresia

Duodenal Atresia –Type …….

Jejunoileal Atresia – Type ……...

Location of atresia …….

PERIOPERATIVE MANAGEMENT

Age at surgery (in days) …….

Surgical procedure done.

- Resection of gut

  -length resected (in cm) - proximal gut ……...

  -distal gut ……...

- Tapering ☐
- Primary Anastomosis ☐
- Stoma fashioning ☐
- Other …….

Perioperative Laboratory Investigations

Laboratory investigation	Preoperative values	Postoperative values at week 1	Postoperative values at week 2
WBC (10^9/L)			
Hemoglobin (g/dl)			
Platelets (10^9/L)			
Albumin (g/dL)			
Total bilirubin(mg)			
Direct bilirubin(mg)			
Sodium (mmol/L)			
Potassium (mmol/L)			
urea (mg/dL)			
creatinine(mg/dL)			

Admission to neonatal ICU ☐

Use of Total Parenteral Nutrition- ☐

Duration of use of TPN ……

Reintroduction of enteral feeds postoperatively- ……...

Complications

-SSI ☐ -Reoperation ☐ -other……..
-Wound dehiscence ☐ -Stoma complications ☐
-sepsis ☐ -

OUTCOME

-Duration to full enteral feeds (in days) ……

-length of hospital stay (in days) ……

- Mortality- ☐