UNIVERSITY OF RWANDA
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DEPARTMENT OF SURGERY

CHALLENGES OF NEONATAL SURGERY AT CHUK

Submitted in partial fulfillment of the requirements for the award of the Degree of Master of Medicine in General Surgery, University of Rwanda

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DECLARATION

***The researcher*:**

I hereby declare that this dissertation is my own work and it has not been submitted by me to any other University for the award of a degree.

Date: August, 2017

Dr GAHEMBA Innocent

The supervisor:

I hereby declare that this dissertation**: "CHALLENGES OF NEONATAL SURGERY AT CHUK"** was submitted by Dr GAHEMBA Innocent with my approval.

Signed……..…..

Dr Michael CURCI

Date: August, 2017

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Finally, to you members of my family, parents, your love and support fuelled my progress to success.

For you all cited or forgotten, contributed to my training, I say thank you.

GAHEMBA Innocent, MD

DEDICATION

To my beloved wife, MUJAWAYEZU Laetitia

My son: IMENA GAHEMBA Ryan

Parents,

Patients I worked with

Contents

DECLARATION 2
ACKNOWLEDGEMENTS 3
DEDICATION 3
LIST OF ABBREVIATIONS 7
ABSTRACT 8
CHAPTER I: INTRODUCTION 9
1.1 BACKGROUND 9
1.2 PROBLEM STATEMENT 9
1.3 AIM 9
1.4 RESEARCH QUESTION 9
1.5 OBJECTIVES OF THE STUDY 10
A. GENERAL 10
B. SPECIFIC 10
CHAPTER II: LITERATURE REVIEW 11
2. 1. GENERAL CONSIDERATIONS 11
2.1.2 Types and definitions 12
2.2 EPIDEMIOLOGY 14
CHAPTER III: METHODS 20
3.1 STUDY DESCRIPTION 20
3.2 STUDY DESIGN 20
3.3 STUDY POPULATION 20
3.4 SELECTION OF STUDY POPULATION 20
3.4.1 INCLUSION CRITERIA 20
3.4.2 EXCLUSION CRITERIA 20
3.5 STUDY SETTING 21
3.6 SAMPLING METHOD 21
3.7 SAMPLE SIZE CALCULATION 21
3.8 DATA COLLECTION 21
3.9 DATA PROCESSING AND ANALYSIS 21
3.10 ETHICAL CONSIDERATIONS 22

A. CONFIDENTIALITY 22
B. INFORMED CONSENT 22
C. ETHICAL APPROVAL 22
CHAPTER IV: RESULTS 23
CHAPTER V: DISCUSSION 44
CHAPTER IV: CONCLUSION AND RECOMMENDATIONS 46
REFERENCES 47
APPENDIX 1: QUESTIONNAIRE 49
APPENDIX 2: CONSENT FORM 52

LIST OF ABBREVIATIONS

BPM: Beat per minute

ARM: Ano-rectal malformation

CHUK: Centre Hospitalier Universitaire de Kigali

CM: Congenital Malformation

CMHS: College of Medicine and Health Sciences

CT: Computed tomography

GI: Gastro-intestinal

GIT: Gastro-intestinal tract

HR: Heart Rate

IRB: Institutional Review Board

KFH: King Faisal Hospital

NEC: Necrotizing enterocolitis

RMH: Rwanda Military Hospital

SSA: Sub-Saharan Africa

SPSS: Statistical package for the social science

TOF: Tracheo-esophageal fistula

WHO: World Health Organization

ABSTRACT

Introduction

Africa has one of the highest neonatal mortalities in the world, for which the commonest causes include surgical conditions such as some congenital anomalies that are amenable to surgery but are not often operated on because of a number of challenges. These challenges include cultural beliefs and practices, lack of human resource capacity, inadequate laboratory and imaging support and lack of consumables and intensive or high dependency care facilities [20].

Methods

This was a prospective descriptive observational study assessing challenges met in management of neonates with surgical conditions.

Neonates entered in the study at admission in pediatric emergency were those with most common neonatal surgical conditions which are: Anorectal malformations (ARM), gastro-intestinal (GIT) Atresias, Omphalocele, Gastrochisis, Hirshprung disease, and congenital diaphragmatic hernia. Patient's age, gender, vitals, diagnosis, imagery and laboratory findings were recorded. Follow up included management, complications and outcome.

Results

Over a 7-month period, there were 90 patients enrolled in the study with 58(64.4%) males and the rest 32(35.6%) females. The large number of neonates in our study were born at health centers (55.6%) and district hospitals (38.9%). The time between birth and arrival at CHUK was between 0-30 days with the mean of 4.6 days. Most neonates in the study had diagnosis of ano-rectal malformation (34.4%) followed by GIT Atresias (21.1%), omphalocele (17.8%), gastrochisis (13.3%),Hirshprung disease (8.9%) and congenital diaphragmatic hernia (4.4%). Forty-eight (53.3%) neonates in our study underwent operation in OR while 26(28.9%) were managed non-operatively.

Sixteen (17.8%) were not managed at CHUK: some have been counter referred and others died before proposed management. Among 90 neonates included in our study, 12(13.3%) died and 78 (86.3%) were discharged. 59(65.6%) were given appointment to be followed as outpatient, 17(18.9%) were discharged for palliative care at nearest health facility and 2(2.2%) were referred to another tertiary hospital (one at KFH, another at RMH)

CHAPTER I: INTRODUCTION

1.1 BACKGROUND

Africa has one of the highest neonatal mortalities in the world, for which the commonest causes include surgical conditions such as some congenital anomalies that are amenable to surgery but are not often operated on because of a number of challenges. These challenges include cultural beliefs and practices, lack of human resource capacity, inadequate laboratory and imaging support and lack of consumables and intensive or high dependency care facilities[20].

1.2 PROBLEM STATEMENT

Globally, the major causes of neonatal deaths are birth asphyxia, prematurity and severe infections. Little attention is paid to deaths contributed by surgically amenable conditions [14].
The outcome of neonatal surgery has significantly improved over the decades in high-income countries. In sub-Saharan Africa (SSA), however, it has lagged behind [13].
CHUK, as referral hospital, receives a large number of neonates requiring emergency surgery.
CHUK has got a PICU(pediatric intensive care unit) with only 3 functioning ventilator machines and only one can be used by neonates with low weight.
Cost and non availability of TPN (Total parenteral nutrition) impose a great challenge to the survival of neonates with surgical conditions.
For several reasons, neonates with emergent surgical conditions delay to arrive at CHUK.

1.3 AIM

The aim of this study was to identify the challenges of neonatal surgery at CHUK which are the origin of uncounted complications in our daily practice.

1.4 RESEARCH QUESTION

Is delayed operation associated with mortality in neonates with emergent surgical condition?

1.5 OBJECTIVES OF THE STUDY

A. GENERAL

To describe the challenges of neonatal surgery at CHUK

B. SPECIFIC

-To determine the burden of most common congenital emergent surgical conditions of neonates at CHUK

-To describe causes of complications in neonates with surgical conditions at CHUK

- To determine the outcome of neonates managed with surgical conditions at CHUK

-To give recommendations

CHAPTER II: LITERATURE REVIEW

2. 1. GENERAL CONSIDERATIONS

The complexity of embryonic development is reflected in the varied range of syndromes and abnormalities associated with GI malformations. This is illustrated by many associated conditions and syndromes.
For example: The mnemonic **'VACTERL'** describes a condition of associated multiple abnormalities, some within and some outside the gut. Initially named as the VATER association, the condition is usually sporadic and the incidence is estimated between 1 in 10,000 to 40,000 births. It is diagnosed if there are at least three of the six defects.

Vertebral defects include single or multiple hemivertebrae, scoliosis or deformities of ribs.

Anorectal malformations including imperforate anus and cloacal deformities.

Cardiovascular defects, especially ventricular septal defect (the most common), Fallot's tetralogy, patent ductus arteriosus, atrial septal defects, aortic coarctation, right-sided aortic arch, single umbilical artery, and others.

Tracheo-oesophageal defect include esophageal atresia with or without tracheo-oesophageal fistula (TOF).

Renal anomalies including renal agenesis as with Potter's syndrome, bilateral renal agenesis or dysplasia, horseshoe kidney, polycystic kidneys, urethral atresia and ureteral malformations.

Limb deformities including radial dysplasia, absent radius, radial deformities, syndactyly, polydactyly, lower-limb tibial deformities.

Kartagener's syndrome is an autosomal recessive condition associated with situs inversus and GI malformations. A significant proportion of patients with situs inversus have congenital GI malformations such as duodenal atresia, biliary atresia, gastroschisis with malrotation or TOF.

The Pentalogy of Cantrell is a rare syndrome comprising defects of the diaphragm, abdominal wall, heart and sternum. Specifically, the syndrome includes omphalocele, diaphragmatic hernia (anterior), sternal cleft and ectopia cordis.

2.1.2 Types and definitions

A. ESOPHAGEAL ATRESIA

Esophageal atresia has an estimated incidence of 1 in 3,000 births. The recurrence risk in subsequent pregnancies of esophageal atresia that is not part of a syndrome is less than 1%.
It is two to three times more common in twins than in singletons. It is more common in the trisomy disorders of Down's syndrome, Patau's syndrome and Edwards' syndrome.
About half have other congenital abnormalities too, usually of urogenital, cardiovascular or colorectal systems. Hence, there would seem to be some genetic component involved but its contribution is unclear. Around 85% have a distal TOF. Around 10% have no fistula and the remainder is a mixture of proximal fistula, more than one fistula and fistula without atresia.
Feeding can lead to aspiration and early surgical repair is essential for survival.

B.OMPHALOCELE AND GASTROSCHISIS

Omphalocele and gastroschisis occur in about 1 birth in 3,000.
There is a deficiency of the abdominal wall and contents can herniate into this space.
Prune belly syndrome is a rare condition in which about 97% are boys. There is deficiency of the abdominal wall and cryptorchidism, hydronephrosis and possibly pulmonary hypoplasia but the gut is usually intact.

C. CONGENITAL DIAPHRAGMATIC HERNIA

Congenital diaphragmatic hernia results from failure of diaphragm to fuse during fetal development allowing abdominal organs to migrate into the chest.

Presence of abdominal viscera in the chest interferes with lung development and can result in pulmonary hypoplasia and pulmonary hypertension in severe cases.
Diagnosis is often made antenatally and most cases are symptomatic at birth, requiring ventilator support and aggressive treatment of pulmonary hypertension.
Milder cases can present later in life, sometimes even in adulthood.
Surgical repair which involves replacing the abdominal contents into the abdominal cavity and repairing the diaphragmatic defect should be done after full stabilization of the patient.

D. INTESTINAL ATRESIA, STENOSIS AND WEBS

These can occur at any level but the most common place for atresia, after the esophagus, is the duodenum. The incidence of duodenal atresia is between 1 in 10,000 and 1 in 30,000 births.
Around a third to a half have other abnormalities too. About 30% have Down's syndrome.
About 30% have cardiovascular defects.
Antenatal detection by ultrasound is often possible and polyhydramnios may be a presenting feature. Presentation is with persistent vomiting, often bilious, within hours of birth, although sometimes it may take a couple of days to develop. Lower lesions take longer to develop symptoms.
X-ray will show fewer air levels than expected and may reveal the classical double bubble sign of duodenal atresia. Colonic atresia may also occur. It takes longer to develop and air levels are more normal.
A barium enema may show a small colon, suggestive of a distal small-bowel obstruction. It is also capable of demonstrating other causes of lower obstruction, such as Hirschsprung's disease or a meconium plug. The enema may also enter the small bowel and help demonstrate the level of a distal obstruction.
Surgical correction is required but resuscitation and correction of dehydration must precede surgery. The order or priorities may depend upon other abnormalities.
Combined esophageal and duodenal atresia makes the situation much more complicated.

E. HIRSCHSPRUNG'S DISEASE

Hirschsprung's disease is caused by failure of development of the neural ganglia in the myenteric and submucosal plexus of the rectum.

Delayed passage of meconium is a crucial feature, as nearly half of all infants with Hirschsprung's disease do not pass meconium within 36 hours, and nearly half of infants with delayed first passage of meconium have Hirschsprung's disease.

The affected segment of bowel is of normal caliber whilst the bowel proximal to it is dilated.

A colostomy may be required to permit return to normal of the dilated bowel and then the aganglionic segment must be resected.

It is associated with a number of other conditions but especially Down's syndrome.

F. IMPERFORATE ANUS

Minor abnormalities of the anus or rectum occur in about 1 birth in every 500 but major abnormalities are around 1 in 5,000.

Associated abnormalities of the small intestine, oesophagus, genitourinary system, cardiovascular system and sacral area may also occur.

Failure to pass meconium in the first 24 hours of life should lead to examination of the rectum.

Milder lesions may cause constipation later on.

If there is an adequate amount of gas in the bowel, a plain X-ray will usually suffice for diagnosis. CT or ultrasound is not usually required.

Pre-operative resuscitation is required. The nature of surgery depends upon the precise lesion and other possible complications. Meticulous management gets good results. The importance of accurate diagnosis before surgery is illustrated by a review of management of patients with newborn cloacas.

2.2 EPIDEMIOLOGY

E. Abahuje et al[1], carried out a study between August, 2013 and July, 2014 to describe the pattern of pediatric surgery in Rwanda and to determine the prevalence of pediatric surgical conditions that require the expertise of a Pediatric Surgeon. Data were obtained from theater books and operative database. A total number of 1274 children were operated at Butare and

Kigali University Teaching Hospitals: 391 (30.7) were female and 883 (69.3) were male, with a male to female ratio of 2.2:1. The age ranged between 1 day and 16 years, Mean age was 6.4 ± 4.9 years. Children under five were 45.1%. 857 (67%) children needed the Pediatric Surgery specialty expertise. 369 (29%) patients were operated at Butare University Teaching Hospital, while 905 (71%) were operated on at Kigali University Teaching Hospital. Trauma and burn: 466 (36.58%), congenital anomaly: 298 (23.39%) and Surgical infections: 188 (14.76%) were the three common diagnoses in pediatric surgery.

Estimating pediatric surgical need in developing countries: a household survey in Rwanda. Petroze RT et al[9], conducted a nationwide cross-sectional cluster-based population survey to estimate the magnitude of surgical disease in Rwanda. Conducted as a verbal questionnaire, questions included representative congenital, acquired, malignant and injury-related conditions. Pediatric responses were analyzed using descriptive statistics and univariate analysis. A total of 1626 households (3175 individuals) were sampled with a 99% response rate; 51.1% of all individuals surveyed were younger than age 18. An estimated 50.5% of the total current surgical need occurs in children. Of all Rwandan children, 6.3% (95% CI 5.4%-7.4%), an estimated 341,164 individuals, were identified to have a potentially treatable surgical condition at the time of the interview. The geographic distribution of surgical conditions significantly differed between adults and children ($p<0.001$).

In outcomes and unmet need for neonatal surgery in a resource-limited environment: estimates of global health disparities from Kampala, Uganda, Badrinath R et al[6], examined epidemiology, outcomes, and met and unmet need of neonatal surgical diseases in Uganda Pediatric general surgical admissions and consults from January 1, 2012, to December 31, 2012, at a national referral center in Uganda were analyzed using a prospective database. Outcomes were compared with high-income countries (HICs), and met and unmet need was estimated using burden of disease metrics (disability-adjusted life years or DALYs).23% (167/724) of patients were neonates, and 68% of these survived. Median age of presentation was 5days, and 53% underwent surgery. 88% survived postoperatively, while 55% died without surgery ($p<0.001$). Gastroschisis carried the highest mortality (100%) and the greatest mortality disparity with HICs. An estimated 5072 DALYs were averted by neonatal surgery in Uganda (met need), with 140,154 potentially

avertable (unmet need). Approximately 3.5% of the need for neonatal surgery is met by the health system.

Ekenze SO et al[10], did a literature review by searching PubMed and African Index Medicus for original articles published in any language between January 1995 and September 2014. A data extraction sheet was used to collect information, including type of study, demographics, number of cases, outcome, challenges, and suggestions to improve outcome. A total of 51 studies from 11 countries met the inclusion criteria. The 16 studies in the first 10 years (1995-2004; group A) were compared with the 35 in the last 10 years (2005-2014; group B). Nigeria (n = 32; 62.7 %), South Africa (n = 7; 13.7 %), Tanzania (n = 2; 3.9 %), and Tunisia (n = 2; 3.9 %) were the predominant sources of the publications, which were retrospective in 38 (74.5 %) studies and prospective in 13 (25.5 %) studies. The mean sample size of the studies was 95.1 (range 5-640). Overall, 4849 neonates were studied, with median age of 6 days (range 1-30 days). Common neonatal conditions reported were intestinal atresia in 28 (54.9 %) studies, abdominal wall defects in 27 (52.9 %), anorectal malformations 25 in (49.0 %), and Hirschsprung's disease, necrotising enterocolitis, and volvulus neonatorum in 23 (45.1 %) each. Mortality was lowest (<3 %) in spina bifida and facial cleft procedures, and highest (>50 %) in emergency neonatal surgeries involving bowel perforation, bowel resection, congenital diaphragmatic hernia, esophageal atresia, and ruptured omphalocele or gastroschisis. Overall average mortality rate was higher in group A than group B (36.9 vs 29.1 %; $p < 0.001$), and varied between the groups for some conditions. The major documented challenges were delayed presentation and inadequate facilities in 39 (76.5 %) studies, dearth of trained support personnel in 32 (62.7 %), and absence of neonatal intensive care in 29 (56.9 %). The challenges varied from country to country but did not differ in the two groups.

Rickard JL[11] et al measured the perioperative mortality rate (POMR) and associated factors at a major referral hospital in Rwanda. The POMR was 6 %. POMR in patients under 5 years of age was 10 %, 3 % in patients 5-14 years and 6 % in patients age >14 years. For emergency and elective operations, POMR was 9% and 2 %, respectively. POMR was associated with emergency status, congenital anomalies, repeat operations, referral outside Kigali, and female gender. Orthopedic procedures and age 5-14 years were associated with decreased odds of

mortality. Forty-nine percent of deaths occurred in the post-operative recovery room and 35 % of deaths occurred within the first post-operative day.

Emmanuel A. Ameh et al[13] [Neonatal surgical care: a review of the burden, progress and challenges in sub-Saharan Africa]

Indications for operative emergency neonatal surgery in Zaria, Nigeria (1988–2013)

Causes	Number of cases	%
Anorectal malformation	228	44.2
Exomphalos	73	14.1
Intestinal atresia	47	9.1
Gastroschisis	33	6.4
Intestinal malrotation and volvulus	21	4.1
Esophageal atresia	18	3.5
Strangulated external hernia	16	3.1
Duodenal atresia	12	2.3
Hirschsprung's disease	10	1.9
Necrotising fasciitis	9	1.7
Ruptured/ulcerated sacrococcygeal teratoma	9	1.7
Complications of omphalitis	6	1.2
Posterior urethral valve	4	0.8
Conjoined twins with one dead twin	3	0.6
Bleeding circumcision	3	0.6
Infantile hypertrophic pyloric stenosis	3	0.6
Cervical teratoma obstruction airway	3	0.6

Superficial abscesses	2	0.4
Patent vitelline duct	2	0.4
Hydrometroculpos	2	0.4
Annular pancreas	2	0.4
Trauma	1	0.2
Acute scrotum	1	0.2
Meconium peritonitis	1	0.2
Necrotising enterocolitis	1	0.2
Others	6	1.2
Total	516	100

In another review Rosemary O Ugwu, Philemon E Okoro[14] in Nigeria, Show the types of neonatal surgical conditions and the systems involved. The commonest surgical conditions were due to congenital abnormalities in 408 (88.7%), whereas acquired causes constituted 52 (11.3%) of all the surgical cases. The systems most commonly affected were the digestive system 201 (43.7%), and the central nervous system 116 (25.2%). In 20 (4.3%), the abnormalities were multiple involving three or more systems. Congenital intestinal obstruction, neural tube defect and anterior abdominal wall defect accounted for 129 (31.6%), 101 (24.8%) and 58 (14.2%), respectively, of all the congenital surgical abnormalities, while fractures of the long bones following birth trauma and perforated necrotising enterocolitis (NEC) accounted for 15 (28.8%) and 14 (26.9%), respectively, of all acquired surgical conditions.

For the management and outcome, death occurred in 196 (42.6%). Two hundred and ninety-four (63.9%) did not have surgery and 116 (39.5%) of them died (15 of them were considered ineligible for surgery because of their very poor clinical state and 101 of them while still being stabilized for surgery). A hundred and sixty-six (36.1%) had surgical intervention and 80 (48.2%) of them died after surgery, with 40 (50.0%) of the deaths occurring by the second day postoperatively. There was no significant difference in the number of deaths between those that had surgery and those that did not have surgery ($\chi^2 = 1.12$; $P = 0.3$). Surgery was done more for digestive system conditions and most of the deaths as well occurred in neonates that had surgery for a digestive system disorder. The commonest congenital abnormalities requiring surgery were

anorectal malformation, small intestinal atresia (obstruction), neural tube defects and omphalocoele. The commonest surgical interventions were laparotomy with intestinal resection and anastomosis (either for small intestinal atresia or ruptured NEC) 46 (27.7%), colostomy 23 (13.9%), repair of neural tube defects 19 (11.5%) and closure of abdominal wall defect 17 (10.2%).

Postoperative complications were seen in 98 (59%) and include infection in 68 (69.4%), anastomotic leak in nine (9.2%), burst abdomen in six (6.1%), enterocutaneous fistula in four (4.1%), short bowel syndrome in four (4.1%), acute renal failure in two (2%) and colostomy prolapse in two (2%). Intractable hypoglycaemia occurred in three (3.1%) as a result of difficult intravenous access from thrombosed vessels necessitating multiple venous cut downs. Nine had a repeat surgery because of post-operative complications and seven (78%) of them died within 2 days of the second surgery. Significantly, more deaths occurred in preterm babies (34/41 for preterms vs. 162/419 for term babies $\chi^2 = 8.84$; $P = 0.003$) and those babies delivered outside the hospital (25/95 for inborn vs. 171/365 for out-borns $\chi^2 = 5.22$; $P = 0.02$). Sepsis was the commonest cause of death in 92 (47%).

CHAPTER III: METHODS

3.1 STUDY DESCRIPTION

Neonates entered in the study at admission in emergency pediatric were those with most common surgical conditions in neonates which are: Anorectal malformations, Atresias, Omphalocele, Gastrochisis, Hirshprung disease, and congenital diaphragmatic hernia. Patient's age, gender, vitals, diagnosis, imagery and laboratory findings were recorded. Follow up included management, complications and outcome.

3.2 STUDY DESIGN

This was a prospective descriptive observational study assessing challenges encountered in management of neonates with surgical conditions.

3.3 STUDY POPULATION

All neonates admitted to the emergency of pediatric at University Teaching Hospital of Kigali who met the inclusion criteria till the sample size is obtained.

3.4 SELECTION OF STUDY POPULATION

3.4.1 INCLUSION CRITERIA

Any admitted neonate with one of selected most common surgical condition. Those are : Anorectal malformations, Atresias, Omphalocele, Gastrochisis, Hirshprung disease, and congenital diaphragmatic hernia

3.4.2 EXCLUSION CRITERIA

-Age>1month at admission

-Refusal to sign consent by parents.

-No parents available to sign consent

3.5 STUDY SETTING

The study was conducted in the department of pediatrics and surgery at University Teaching Hospital of Kigali, a national referral hospital.

3.6 SAMPLING METHOD

All patients meeting the selection criteria, during the study period, were included in the study after receiving an informed consent.

3.7 SAMPLE SIZE CALCULATION

$$n=(z^2)*p*q/d^2$$

For Z=1.96, P=6.2%, d=0.05 sample size is estimated to be 90 individuals

3.8 DATA COLLECTION

Data were collected using a questionnaire. The following data were collected for the study:

1. Age
2. Sex
3. Symptoms
4. Vitals at arrival
5. Findings on physical examination
6. Investigations done
7. Surgical intervention
8. Complications post intervention
9. Proposed discharge plan

3.9 DATA PROCESSING AND ANALYSIS

Data were collected using a standardized questionnaire during recruitment and follow up of the patients. A data base was created using SPSS software and it was used for data analysis. Means & standard deviations were used for normally distributed data and Chi-square tests for associations between groups.

3.10 ETHICAL CONSIDERATIONS

A. CONFIDENTIALITY

The information will be kept confidential by the research team. Not any patient's identification was requested on the data collection or questionnaire sheets. After being enrolled in the study, the patient was assigned a number that was different from his Hospital ID number.

B. INFORMED CONSENT

An informed consent was obtained from the legally recognized attendant at the recruitment (only father or mother). Participation in the study was voluntarily and one of parents has rights to withdraw from the study at any time during the study. The study was conducted according to the principles of good clinical practice for the best treatment.

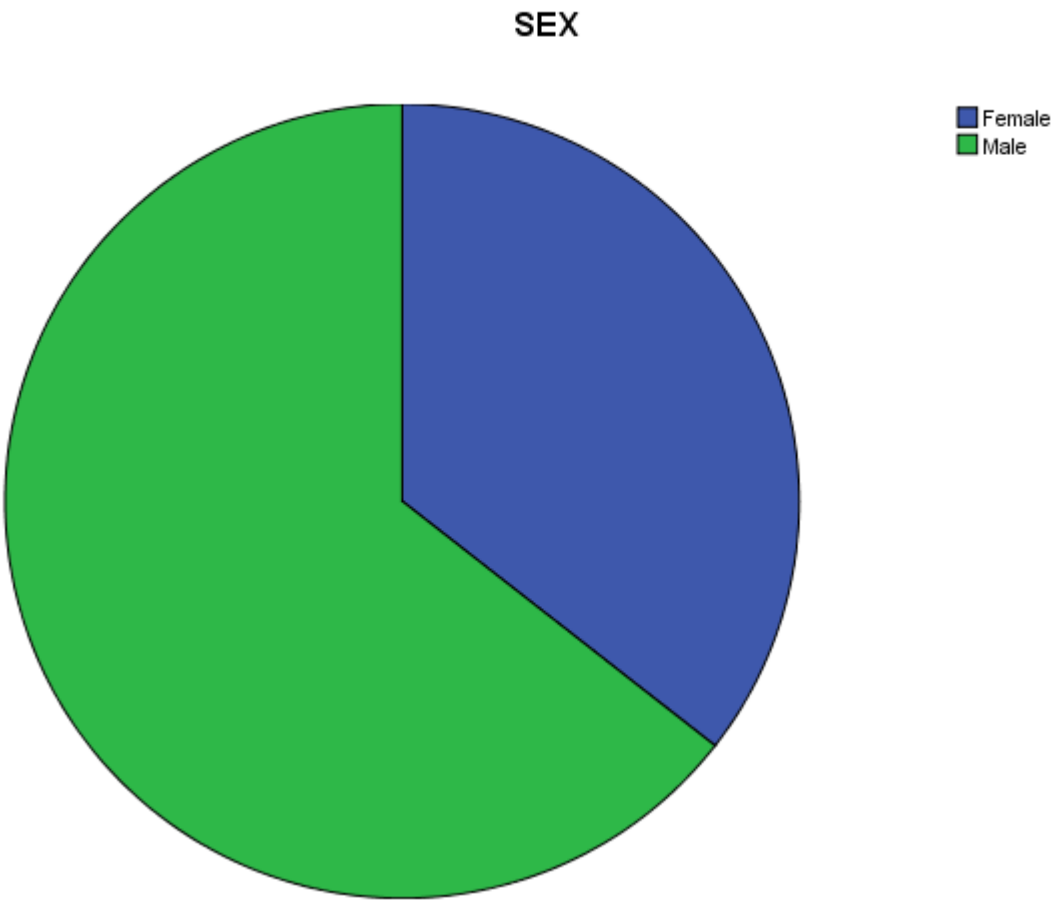
C. ETHICAL APPROVAL

The research proposal was submitted to the Department of Surgery / CHUK for clearance and it was submitted to the CMHS IRB for review. The research proposal was also approved by ethic and research committees of the University Teaching Hospital of Kigali (CHUK).

CHAPTER IV: RESULTS

SEX

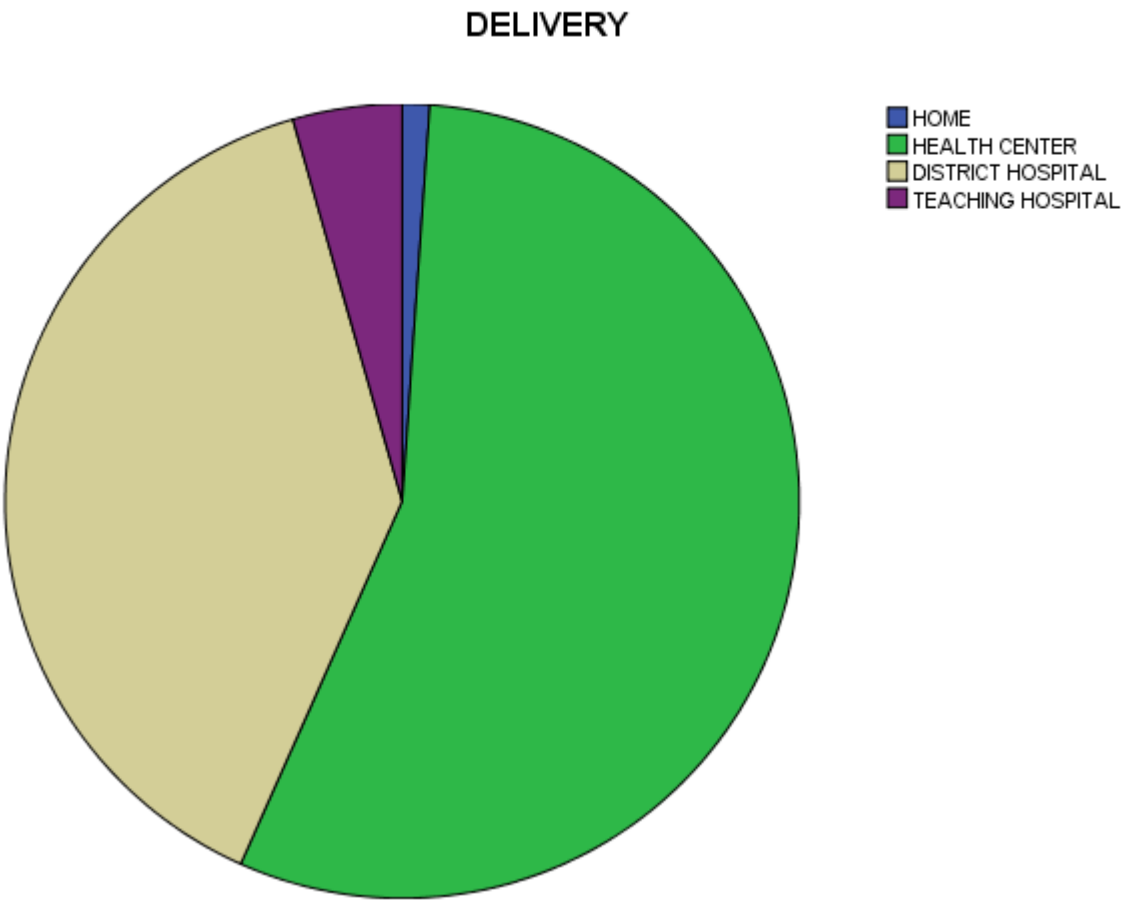
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Female	32	35.6	35.6	35.6
	Male	58	64.4	64.4	100.0
	Total	90	100.0	100.0	



Most of neonates in the study were males 64.4% with 35.6% females

DELIVERY

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	HOME	1	1.1	1.1	1.1
	HEALTH CENTER	50	55.6	55.6	56.7
	DISTRICT HOSPITAL	35	38.9	38.9	95.6
	TEACHING HOSPITAL	4	4.4	4.4	100.0
	Total	90	100.0	100.0	



The large number of neonates in our study were born at health centers (55.6%) and district hospitals (38.9%) with only one born at home and four at teaching hospital level.

TIME BETWEEN BIRTH AND ARRIVAL AT CHUK

N	Valid	90
	Missing	0
Mean		4.66
Median		2.00
Mode		1[a]
Std. Deviation		6.914
Minimum		0
Maximum		30
Percentiles	25	1.00
	50	2.00
	75	4.25

TIMEBETWEENBIRTHANDARRIVALATCHUK

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0	6	6.7	6.7	6.7
	1	23	25.6	25.6	32.2
	2	23	25.6	25.6	57.8
	3	13	14.4	14.4	72.2
	4	3	3.3	3.3	75.6
	5	3	3.3	3.3	78.9
	6	4	4.4	4.4	83.3
	7	3	3.3	3.3	86.7
	8	1	1.1	1.1	87.8
	9	1	1.1	1.1	88.9
	10	1	1.1	1.1	90.0
	15	1	1.1	1.1	91.1
	16	2	2.2	2.2	93.3
	24	1	1.1	1.1	94.4
	25	1	1.1	1.1	95.6
	26	1	1.1	1.1	96.7
	30	3	3.3	3.3	100.0
	Total	90	100.0	100.0	

The time between birth and arrival at CHUK was between 0-30 days with the mean of 4.6 days

HR

N	Valid	83
	Missing	7
Mean		139.83
Median		140.00
Std. Deviation		13.978
Minimum		102
Maximum		165

Mean heart rate was 139.8 bpm

SATURATION

N	Valid	83
	Missing	7
Mean		95.64
Median		96.00
Std. Deviation		2.717
Minimum		84
Maximum		100

Mean oxygen saturation was 95.6% on room air

RR

N	Valid	83
	Missing	7
Mean		45.83
Median		44.00
Std. Deviation		8.079
Minimum		34
Maximum		76

Mean respiratory rate at arrival was 45.8 cycle per minute

Birth weight

N	Valid	90
	Missing	0
Mean		2.8667
Median		2.9000
Std. Deviation		.49023
Minimum		1.62
Maximum		4.20

Weight at arrival

N	Valid	89
	Missing	1
Mean		2.7765
Median		2.8000
Std. Deviation		.56641
Minimum		1.14
Maximum		4.00

Mean birth weight was 2.86 kg while weight at arrival at CHUK was lower(2,77kg)

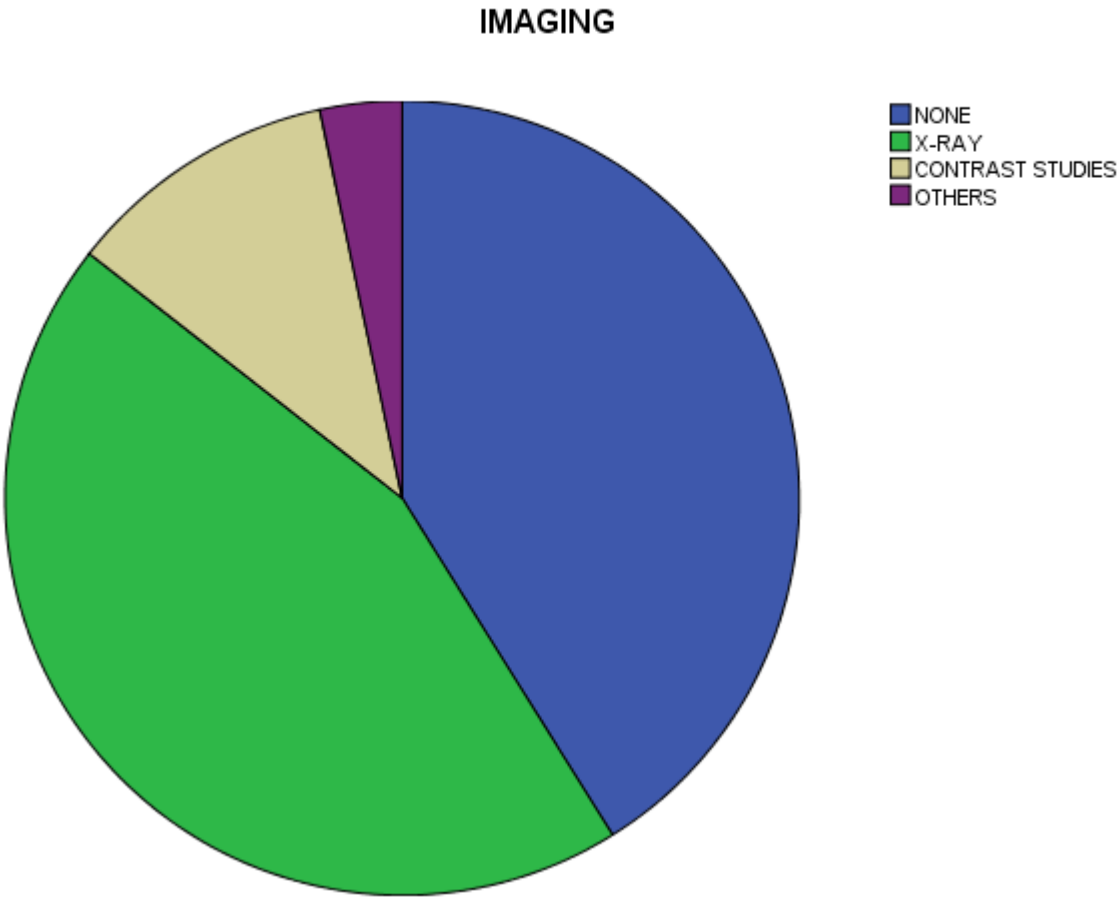
WEEKS OF AMENORRHEA

N	Valid	90
	Missing	0
Mean		38.81
Median		39.00
Mode		40
Std. Deviation		1.557
Minimum		32
Maximum		41

Neonates included in this study were born between 32 and 41 weeks of amenorrhea with the mean of 38.8 weeks of amenorrhea

IMAGING

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	NONE	37	41.1	41.1	41.1
	X-RAY	40	44.4	44.4	85.6
	CONTRAST STUDIES	10	11.1	11.1	96.7
	OTHERS	3	3.3	3.3	100.0
	Total	90	100.0	100.0	



Most neonates had an x-ray as imaging modality (44.4%) while 41.1% of diagnoses were clinical without imaging while 11.1% had contrast studies

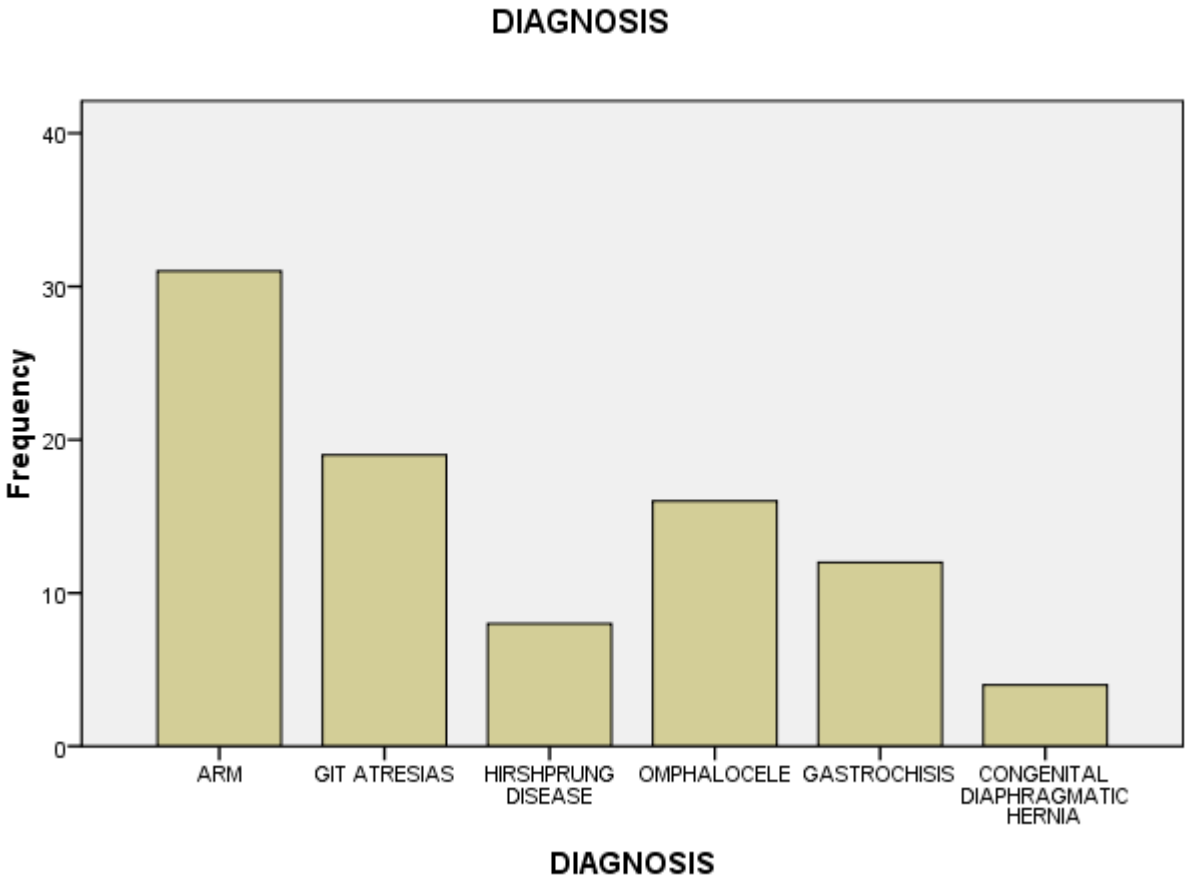
BIOPSY

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	YES	6	6.7	6.7	6.7
	NO	84	93.3	93.3	100.0
	Total	90	100.0	100.0	

Biopsy was taken to 6 neonates with suspicion of Hirshprung disease

DIAGNOSIS

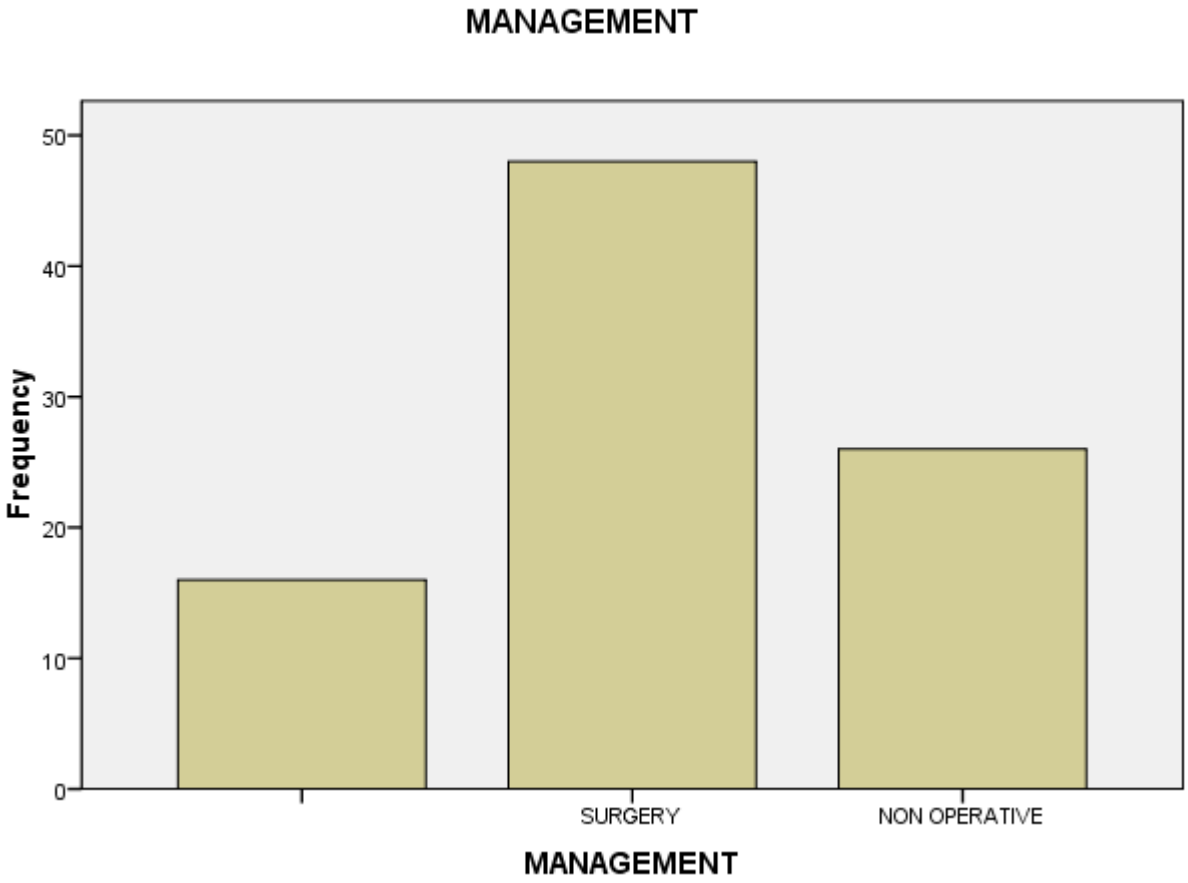
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	ARM	31	34.4	34.4	34.4
	GIT ATRESIAS	19	21.1	21.1	55.6
	HIRSHPRUNG DISEASE	8	8.9	8.9	64.4
	OMPHALOCELE	16	17.8	17.8	82.2
	GASTROCHISIS	12	13.3	13.3	95.6
	CONGENITAL DIAPHRAGMATIC HERNIA	4	4.4	4.4	100.0
	Total	90	100.0	100.0	



Most of neonates in the study had diagnosis of ARM (34.4%) followed by GIT Atresias (21.1%), omphalocele (17.8%) , gastrochisis (13.3%), Hirshprung disease (8.9%), congenital diaphragmatic hernia (4.4%)

MANAGEMENT

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		16	17.8	17.8	17.8
	SURGERY	48	53.3	53.3	71.1
	NON- OPERATIVE	26	28.9	28.9	100.0
	Total	90	100.0	100.0	



Forty-eight (53.3%) neonates in our study underwent operation in OR while 26(28.9%) were managed non-operatively.

Sixteen (17.8%) were not managed at CHUK, some have been counter referred others died before proposed management.

NONOPERATIVE

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		74	82.2	82.2	82.2
	DRESSING	13	14.4	14.4	96.7
	ENEMAS	1	1.1	1.1	97.8
	OBSERVATION	1	1.1	1.1	98.9
	SILLON BAG	1	1.1	1.1	100.0
	Total	90	100.0	100.0	

Among 16 neonates with non-operative management, 13(14.4%) only had dressing mostly among those with omphalocele, one with Hirshprung disease was managed with saline ENEMAS, another with congenital diaphragmatic hernia was only observed and another with gastrochisis had sillon bag.

TIME WAITED FOR SURGERY

N	Valid	48
	Missing	42
Mean		4.35
Median		1.00
Mode		1
Std. Deviation		6.920
Minimum		0
Maximum		30

TIME WAITED FOR SURGERY

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0	8	8.9	16.7	16.7
	1	17	18.9	35.4	52.1
	2	6	6.7	12.5	64.6
	3	1	1.1	2.1	66.7
	4	2	2.2	4.2	70.8
	5	4	4.4	8.3	79.2
	6	1	1.1	2.1	81.2
	7	1	1.1	2.1	83.3
	8	1	1.1	2.1	85.4
	10	3	3.3	6.2	91.7
	15	1	1.1	2.1	93.8
	26	1	1.1	2.1	95.8
	27	1	1.1	2.1	97.9
	30	1	1.1	2.1	100.0
	Total	48	53.3	100.0	
Missing	System	42	46.7		
Total		90	100.0		

Time between arrival and surgery for those who had surgical operation was between 0 and 30 days with the mean of 4.35 days, the mode is one day

CAUSES OF DELAY OF SURGERY

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		63	70.0	70.0	70.0
	WAIT RESUSCITATION	5	5.6	5.6	75.6
	WAIT INVESTIGATIONS	10	11.1	11.1	86.7
	NO PICU BED	12	13.3	13.3	100.0
	Total	90	100.0	100.0	

Among 48 who had surgical intervention, 27 had delayed operation (more than 1day after arrival) among them 12(13.3%) were waiting for PICU bed, 10(11.1%) were waiting for investigations, and 5(5.6%) were waiting for resuscitation and optimization before surgery.

QUALIFICATION OF OPERATOR

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		42	46.7	46.7	46.7
	RESIDENT	27	30.0	30.0	76.7
	GENERAL SURGEON	19	21.1	21.1	97.8
	PEDIATRIC SURGEON	2	2.2	2.2	100.0
	Total	90	100.0	100.0	

For those operated, 27(30%) were operated by residents, 19(21.1%) by a general surgeon, and 2(2.2%) by a pediatric surgeon.

TYPE OF SURGERY

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		42	46.7	46.7	46.7
	DIVERTING COLOSTOMY	34	37.8	37.8	84.4
	FEEDING GASTROSTOMY	6	6.7	6.7	91.1
	DEFINITIVE SURGERY	8	8.9	8.9	100.0
	Total	90	100.0	100.0	

34(37.8%) of those operated were given a diverting colostomy, 8(8.9%) had definitive surgery while 6(6.7%) had feeding gastrostomy with or without esophagostomy

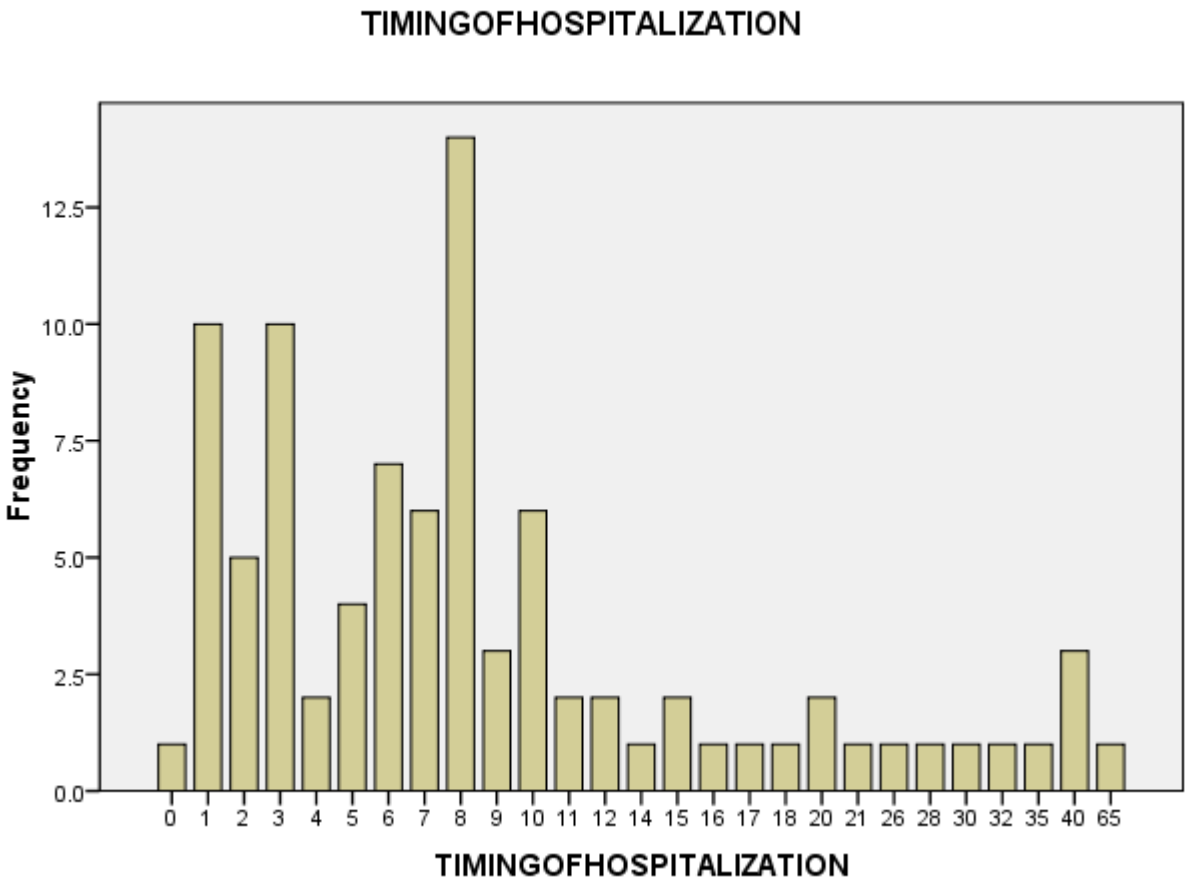
COMPLICATIONS DURING SURGERY

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		42	46.7	46.7	46.7
	BLADDER INJURY	1	1.1	1.1	47.8
	NONE	47	52.2	52.2	100.0
	Total	90	100.0	100.0	

Only one neonate had iatrogenic bladder injury during operation no other complications during operation.

TIMING OF HOSPITALIZATION

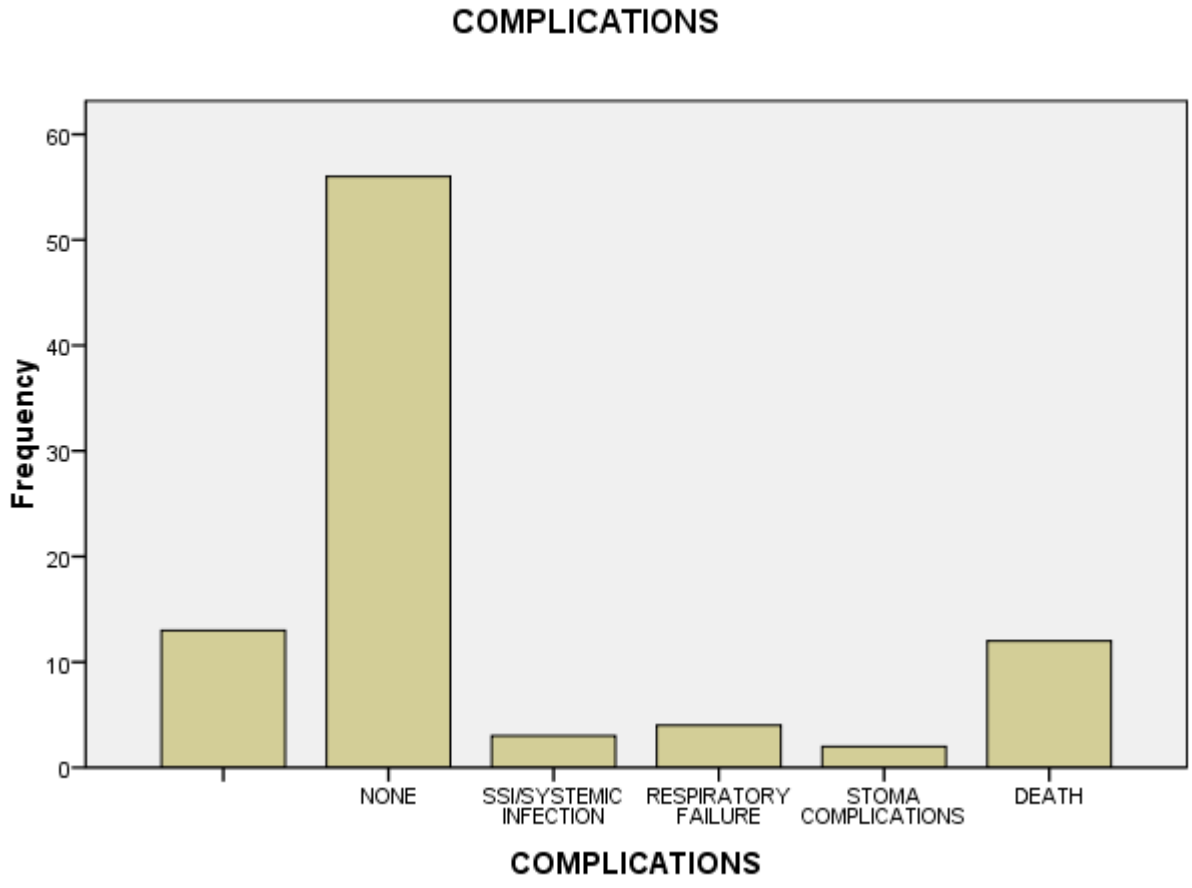
N	Valid	90
	Missing	0
Mean		9.99
Median		7.50
Mode		8
Std. Deviation		10.850



Hospitalization was between 0 and 65 days. The mean is 9.99 days and the mode is 8days

COMPLICATIONS

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		13	14.4	14.4	14.4
	NONE	56	62.2	62.2	76.7
	SSI/SYSTEMIC INFECTION	3	3.3	3.3	80.0
	RESPIRATORY FAILURE	4	4.4	4.4	84.4
	STOMA COMPLICATIONS	2	2.2	2.2	86.7
	DEATH	12	13.3	13.3	100.0
	Total	90	100.0	100.0	



During observation, death occurred on 12(13.3%) Other complications were infection 3(3.3%), respiratory failure 4(4.4%), and stoma complications 2(2.2%)

DISCHARGE PLAN

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		12	13.3	13.3	13.3
	PALLIATIVE CARE	17	18.9	18.9	32.2
	FOLLOW UP IN OPD	59	65.6	65.6	97.8
	REFER TO ANOTHER TERTIARY HOSPITAL	2	2.2	2.2	100.0
	Total	90	100.0	100.0	

Among 90 neonates included in our study, 12(13.3%) died and 78 (86.3%) were discharged. 59(65.6%) were given appointment to be followed as outpatient, 17(18.9%) were discharged for palliative care at nearest health facility and 2(2.2%) were referred to another tertiary hospital (one at KFH, another at RMH)

TIMENGOFSURGERY * DEATH Crosstabulation

Count				
		DEATH		
		YES	NO	Total
TIMENGOFSURGERY	0	0	8	8
	1	1	16	17
	2	0	6	6
	3	0	1	1
	4	0	2	2
	5	0	4	4
	6	0	1	1
	7	0	1	1
	8	0	1	1
	10	2	1	3
	15	1	0	1
	26	0	1	1
	27	0	1	1
	30	0	1	1
Total		4	44	48

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	26.952[a]	13	.013
Likelihood Ratio	16.111	13	.243
N of Valid Cases	48		

There is association between time spent before surgery and post operation death (p-value=0.013)

CHAPTER V: DISCUSSION

In this study,90 neonates were recruited. 64.4% were males while 35.6% were females with a male female sex ratio of 1.8/1 Figures similar to those found by E. ABAHUJE et al (2016)[1] 30.7% female and 69.3% male, and a male to female ratio of 2.2:1. Mohammad Zeeshan Raza et al (2012)[2] had the same result with Male 401(68.3) Female 186(31.7) with male female sex ratio of 2.1/1. Ouédraogo I et al[3] had the same results on 102 cases collected wherein males comprised 60.8% of the cases. The sex-ratio was 1.55. Bertin Dibi Kouame[4] et al had similar results. There were 1.632 newborns with 1.725 congenital abnormalities; the sex ratio was 1.49.

Birth weight was 2.8kg with SD 0.4. In their study, Mohammad Zeeshan Raza et al[2], found mean ± SD birth weight was 3139 ± 242 grams.

Age at arrival at CHUK was between 0-30 days with the mean of 4.6 days. This is similar to what was found by Ouédraogo I et al[3] in Ouagadougou the average age of patients was 5 days with the 0- to 5-day-old age group presenting most frequently. The same results were obtained by Raghav Badrinath et al[6] in Uganda where median age of presentation was 5 days

Most of neonates in the study had diagnosis of ARM (34.4%) followed by GIT Atresias (21.1%) , omphalocele (17.8%), gastrochisis (13.3%), Hirshprung disease (8.9%) , congenital diaphragmatic hernia (4.4%).

In their study, Ouédraogo I et al[3] found that Congenital pathology accounted for 95.5% of cases with anorectal malformations (ARM) (35; 95%) and omphaloceles (28.1%). Hirschsprung disease was the main cause of bowel obstruction other than ARM (50%).

Time between arrival and surgery for those who had surgical operation was between 0 and 30 days with the mean of 4.35 days Ouédraogo I et al[3] reported the average time to surgery was about 2.54 days

Forty-eight (53.3%) neonates in our study underwent operation while 26(28.9%) were managed non-operatively. Sixteen(17.8%) were not managed at CHUK, some have been counter referred

while others died before proposed management. This is similar to what was found by Raghav Badrinath et al[6] in Uganda where 53% underwent surgery

Thirty-four (37.8%) of those operated on were given a diverting colostomy, 8(8.9%) had definitive surgery while 6(6.7%) had feeding gastrostomy with or without esophagostomy. In their study, Pranshu Bhargava et al[8] in INDIA found that out of 45 neonates with ARM, 8 males underwent anoplasty for low ARM, whereas remaining 37 patients required colostomy. None of the female neonates showed low ARM without fistula.

During observation, death occurred for 12(13.3%) and 17(18.9) were discharged for palliative care at nearest health facility without management making mortality 32.2% other complications were infection 3(3.3%), respiratory failure 4(4.4%), and stoma complications 2(2.2%).
The same outcome was obtained by Ouédraogo I et al[3] where overall mortality of neonatal surgical emergencies was 30.3% and postoperative mortality 32.35%
Raghav Badrinath et al[6] in Uganda reported that 88% survived postoperatively, while 55% died without surgery ($p < 0.001$). Gastroschisis carried the highest mortality (100%) and the greatest mortality disparity with HICs. An estimated 5072 DALYs were averted by neonatal surgery in Uganda (met need), with 140,154 potentially avertable (unmet need). Approximately 3.5% of the need for neonatal surgery is met by the health system. Marcia L. Feldkamp et al [7] in Utah among the 316 live born infants, 14 (4.4%) died in the first year of life: of these six (42.8%) died in the first month (Fig. 1). All deaths occurred among infants born at less than 37 weeks of gestation. Bertin Dibi Kouame[4] et al reported the overall mortality rate of congenital anomalies was 52% and gastroschisis was the most lethal disease with 100% mortality, neonatal occlusions 52%, oesophageal atresia 50% of deaths. Mhando S et al[5] in Tanzania, reported that emergency operative mortality was 34%

CHAPTER IV: CONCLUSION AND RECOMMENDATIONS

Thanks to effort made by both government of Rwanda, MOH, and CHUK who have made improvements to the health system of RWANDA, through new materials and education of medical personnel.

Still there is a lot to do to meet the standard of care of neonates with surgical conditions and to have better outcome compared to the developed countries.

TO MOH

To include surgery in National priorities

To provide protocols on the diagnosis and management of neonatal surgical conditions at the level of health centers and district hospitals.

To distribute limited materials and resources equitably to all hospitals.

TO THE UNIVERSITY OF RWANDA

To continue the education of medical and nursing personnel in neonatal care.

To provide additional fellowship training of pediatric surgeons in Rwanda.

To conduct a research on the national level to know exact burden of surgical diseases in neonates.

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APPENDIX 1: QUESTIONNAIRE

Date...../..../201..

1. Patient number ☐

2. Sex: Male ☐

Female ☐

3. Where was delivery?

University teaching hospital ☐

District hospital ☐

Health center ☐

At home ☐

4.Time between birth and arrival to CHUK in days ☐

5.Vitals on arrival: Heart rate ☐

O_2 saturation on room air ☐

Respiration rate ☐

Birth weight ☐

Weight at arrival at the hospital ☐

6. Born at how many weeks of amenorrhea ☐

7. Investigations done : None ☐

Plain abdominal x-ray ☐

Abdominal ultrasound ☐

Contrast studies ☐

8. Biopsy done? Yes ☐

No ☐

9. If yes what are findings?.....

10.Diagnosis: ARM ☐

GIT atresias ☐

Hirshprung disease ☐

Omphalocele ☐

Gastrochisis ☐

Diaphragmatic hern ☐

11. Management: Surgery ☐

Non operative ☐

Died before definitive management ☐

12. If non operative management what is done?.....

13. What is time between surgery and arrival in days? ☐

14. What are causes of delayed surgery(surgery after 24hours of arrival at the hospital)

Wait resuscitation ☐

No PICU bed ☐

Operating room or Surgeon not available ☐

Others(specify)…….

15. What is the qualification of the main operator?

Resident ☐

General surgeon ☐

Pediatric surgeon ☐

Others(specify)…….

16. What type of surgery done?.....

17.What are complications during operation ?Hollow viscus perforation ☐

Death ☐

Others (specify) …….

18. What is the overall time of hospitalization in days (Till discharged or death) ☐

19 . What are complications during hospitalization?Systemic infection ☐

Surgical site infection ☐

Respiratory insufficiency ☐

Renal failure ☐

Death ☐

Other(specify) …….

20. What is the discharge plan?

APPENDIX 2: CONSENT FORM

Study no:

Hospital ID:

Purpose of the study

The purpose of this study is to evaluate challenges of neonatal surgery at CHUK.

Risk and benefits

There is no risk for the children in the study as it will not interfere with normal management offered at CHUK

Voluntary participation

Participation in this study is of your free will. Your child will not be denied medical care in case you refuse to participate in the study. You may stop participating at any time with no consequences whatsoever.

Confidentiality

All information will be kept confidential; your identity will not be disclosed to the public.

I have read the abovementioned information/the abovementioned information has been red to me. I have had time to ask questions and got satisfactory answers. I consent voluntarily for my child to participate in this study.

Name of the mother/father……..

Signature ……

Date (day/month/year)……

Enquiries

For any enquiries or further clarification, please contact the following persons:

Dr GAHEMBA Innocent: Principle researcher Tel: +250 788499130

CHAIRPERSON INSTITUTIONAL REVIEW BOARD CMHS PROF KATO J. NJUNWA

TEL 0788490522

AMASEZERANO YO KWEMERA KUJYA MU BUSHAKASHATSI

Nimero y'uwinjiye mu bushakashatsi:

Nimeroy'ibitaro:

Icyo ubushakashatsi bugamije

Ubu bushakashatsi bugamije kureba ibibazo abana bakivuka bakenewe kubagwa bahura nabyo mu bitaro bikuru bya CHUK.

Ingaruka kuri ubu bushakashatsi

Nta ngaruka nimwe izaba ku mwana wagiye muri ubu bushakashatsi kuko ntacyo buzahindura uko umwana yitabwaho mu bitaro bya CHUK

Ubushake bw'umubyeyi

Kwinjira muri ubu bushakashatsi ntabwo ari agahato. Ntabwo umwana wawe azamburwa uburenganzira bwe k'ubuvuzi yagombaga guhabwa nuramuka wanze. Wemerewe guhagarika kuba muri ubu bushakashatsi igihe ushakiye ntangaruka nimwe bizakugiraho.

Ibanga

Amakuru yose azava muri ubu bushakashatsi azakoreshwa mw'ibanga; amazinay'umurwayi ntazigera atanganzwa mu ruhame.

Nyuma yo gusoma/gusomerwa ibikubiye muri aya masezerano, maze guhabwa umwanya wo kubaza ibibazo nari mfite bigasubizwa neza, nemeye nta gahato ko umwana wanjye ajya muri ubu bushakashatsi.

Amazinay'umubyeyi…….

Umukono ……

Italiki (umunsi/ukwezi/umwaka)……

Ibisobanuro/kurenganurwa

Mu gihe wakenera ibisobanuro birenzeho cyangwa kurenganurwa, wahamagara:

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Umuyobozi wa IRB PROF KATO J. NJUNWA TEL 0788490522