THE ROLE OF CONTRAST ENEMA IN THE DIAGNOSIS AND EVALUATION OF LARGE INTESTINES PATHOLOGIES IN CHILDREN

A DISSERTATION SUBMITTED IN PART FULFILLMENT FOR THE AWARD OF MASTERS DEGREE IN DIAGNOSTIC IMAGING AND RADIATION MEDICINE OF UNIVERSITY OF NAIROBI

A CROSSECTIONAL DESCRIPTIVE STUDY CARRIED OUT AT KENYATTA NATIONAL HOSPITAL RADIOLOGY DEPARTMENT

BY DR. ANDAMBI DAVID ANGWEYE MBCHB,

MOI UNIVERSITY

DECLARATION

I, Dr. ANDAMBI DAVID *declare that the work contained* herein is my original idea and has not been presented at any other place to the best of my knowledge.

Signature……Date…….

APPROVAL BY SUPERVISOR

This research proposal has been submitted with my approval as a university supervisor.

DR A. AYWAK, **M.B.Ch.B., M.MED. (U.O.N**), **Lecturer.**

Department of Diagnostic Imaging and Radiation Medicine**, University of Nairobi.**

Signature……Date…….

DEDICATION

I dedicate this work to my family, Caroline Chemtai my dear wife, Sandra my daughter and Ryan my son

ACKNOWLEGEMENTS

I would like to acknowledge the following persons whose efforts made it possible for production of this book

Dr A. Aywak my university supervisor, for encouragement and criticism that helped to produce this thesis.

My family for their patience and help that was much appreciated

The records staff, radiology department staff at KNH, my colleagues and to all those others who put time and manpower towards this end.

ABBREVIATIONS

CE	Contrast enema
CT	Computed Tomography
DCBE	Double Contrast Barium Enema
FP	False positive
GIT	Gastrointestinal Tract
HD	Hirschsprung's disease
IBD	Inflammatory Bowel Disease
KNH	Kenyatta National Hospital
MBChB	Bachelor's Degree in Medicine and Surgery
MMED	Masters Degree in Medicine
MRI	Magnetic Resonance Imaging
NEC	Necrotizing Enterocolitis
POPC	Peadiatric Outpatient Clinic.
SPSS	Statistical Package for Social Sciences
UON	University of Nairobi
US	Ultrasound

DEFINITIONS OF TERMINOLOGIES.

A child

A child is a human being aged 12years and younger. This includes neonates (0-29 days), infants (1month-2years) and children (2years- 12years)

Contrast enema

This is a procedure that uses a contrast media (positive or negative) to better visualize the inside of the colon.

Contrast media

This is the substance which when introduced into the body will increase the radiographic contrast in an area where it was absent or low.

Sensitivity:

The sensitivity of an examination is shown by the percentage of all patients with the disease for whom a true positive is found

Specificity:

The specificity of an examination is shown by the percentage of patients without the disease for whom a true negative is found

False Positive:

This is where an examination suggests the presence of a disease which does not truly exist.

False Negative:

This is where an examination fails to show a disease when it actually present.

TABLE OF CONTENTS

ABSTRACT

INTRODUCTION

The widespread use of contrast radiography has made it easier to diagnose and treat many Gastro-intestinal tract (GIT) conditions in both children and adults. Apart from barium, other contrast media such as Gastrografin and air have been employed as contrast with good results

OBJECTIVE

The main objective of the study was to determine the role of contrast enema in the diagnosis and management of large bowel pathologies in children aged twelve years and below.

The other objectives were to determine the common indications for contrast enemas, disease pattern in children undergoing enemas, age and sex distribution of common pathologies.

STUDY DESIGN AND SETTING

A cross sectional descriptive study was carried out at Kenyatta National Hospital radiology department.

METHODOLOGY

A total of 92 patients who consented were entered from November 2009 to November 2010. Only 5 patients did not consent. Contrast enema using barium sulphate or iodinated water soluble was carried out on a Fluoroscopy Machine, Diagnoset 15 Model, manufactured by Phillips in 1992.

RESULTS

Ninty two patients were studied by contrast enema. The main radiological findings were: normal (63 %), hirshsrung (17.4%) atreasia with fistula (5.4 %) Atreasia without fistula(5.4%), feacal impaction (3.3%) meconium plug(3.3%) parasitic infestation(1.1 %).Ancillary investigations done were plain films(14.1 %.) and Ultrasound(10.9%) of patients and biopsy done on 17.4 % of patients. The main clinical question was to evaluate value of contrast enema in children suspected to have large bowel pathology

CONCLUSION

Contrast enema examination was found to be highly sensitive (92%) for congenital obstructive colonic pathologies, which correlated well with other local studies that had put sensitivity between 75% - 95% The examination is nonspecific for patients suspected to have inflammatory conditions .

BACKGROUND

Too many structures in the human body remain invisible on x-rays and can only be visualized through use of contrast media or crossectional imaging [1]

In 1808, Sir Humphrey Davy discovered barium, a soft silvery metal that rapidly tarnishes in air and reacts with water. Its radio-opaque characteristic established its utility in outlining the bowel [2]

The significance of contrast media was recognized almost simultaneously with the discovery of x-rays in November 8 1895 by Wilhelm Roentegen.[3]

In March 1896 Becher had outlined the stomach and intestines of sacrificed guinea pig with lead subnitrate [4]

In 1897 Walter B. Cannon. A physiologist who was interested in the motor activities of the stomach undertook a study in a cat, by mixing bismuth substrate with the food he observed movements of the opaque mass in the stomach and described in detail the nature and site of peristaltic activity as seen on a fluoroscopic screen [4]

It was not until 1904, that Schule for the first time attempted an X-ray study of the colon using a bismuth compound enema[5]

In 1969 Noblett introduced gastrographin (meglumine diatriazoate) a water soluble contrast media with a high osmolarity, allowing non operative management of many neonates with uncomplicated meconium ilieus[4]

Contrast radiography has revolutionized the way the gastrointestinal tract can be visualized, enabling many “hidden” areas of the body to be adequately demonstrated and appropriate treatment instituted[1, 4].

The primary contrast imaging methods for detection of colon abnormalities are single contrast (positive contrast alone) and double contrast barium enema (barium sulphate plus air).

The normal colon in the newborn and infants differs in appearance from that of adult in that, the haustal markings are poorly developed, colon is relatively elongated with redundant flexures and cecum relatively high and medially directed.[5] In children single contrast enema is recommended since it is not necessary to demonstrate mucosal pattern except when polyps are suspected DCBE is performed. Bowel preparation is not neccessary[7]

LITERATURE REVIEW

The role of contrast enemas in the management of gastrointestinal tract pathology has come a long way since the introduction of barium and gastrografin. The use of liquids mixed with iodinated compounds and air as contrast agents are gaining in popularity, as they are both cheap and effective alternatives to barium or gastrografin in outlining large bowel pathology. Barium is still widely used in the investigation of suspected large bowel pathology and remains a cost-effective alternative in colorectal cancer screening. Gastrografin is the preferred contrast in children and when perforation is suspected[1].

Literature on the value of contrast enema in children is limited locally. Most studies evaluate the role of contrast enema in a given disease entity.

In a 5 year review and analysis retrospective study of Hirschprung's disease(HD) and other allied disorders at KNH by Mwathi Kamau in 1974 ,it was found out barium enema to be suggestive in 15 (69%) out of 22 patients, while plain abdominal X-ray was suspicious in only 15% in which it was done. He recommended more use of barium enema as a means of diagnosing cases of aganglionosis and megacolon disease.[8]

In 1985 Ondeko carried out a 5 year retrospective study to evaluate the value of barium enema examination on 265 patients (adults and children) at KNH. He found out that specificity of barium enema in ruling out colonic pathology was 96.2 %(177/184). The commonest colonic lesion seen was aganglionosis found in 16(19.8%) of the 81 true positive cases. He concluded that barium enema is a highly sensitive and specific procedure in the diagnosis of aganglionosis and idiopathic megacolon (in children)[9].

Godric Onyango in 2002 did a 10year review of the management of Hirschprung's disease at KNH. He found barium enema to be diagnostic in 65 (69.9 %) of the patients, Plain x-ray was suspicious only in 14% of the cases.[10,] this study has similar findings with that done by Kamau Mwathi [8]

R Y Kanterman et al in 1994 prospectively evaluated a total of nineteen symptoms, signs, and laboratory findings in 471 of 557 consecutive pediatric patients (from newborn to age 12) referred for barium enema examinations, to determine predictors of an abnormal study. A univariate analysis was performed, and a logistic regression model was developed. The most frequent indicators for the barium enema examinations were abdominal pain (48%), constipation (27%) and tenderness (25%). Twenty-two percent of the examinations were abnormal; the indicators that were most helpful to predict a barium enema abnormality were abdominal mass, diarrhea, anemia, tenderness, and age less than 1 year. If barium enema

examinations were performed only when at least one of the predictive indicators was present, 29% of examinations would be eliminated, and 4.8% of patients with detectable disease would be missed. The data indicate that identification of certain clinical variables can provide an effective initial strategy for selecting patients to undergo barium enema examinations[11]

Taxman et al studied the usefulness of the barium enema to rule out Hirschsprung's disease (Congenital megacolon) in the evaluation of infants with constipation. Results from barium enemas in 58 constipated infants and children who underwent rectal suction biopsies to rule out aganglionosis were evaluated in retrospect for the presence of a transition zone, delayed evacuation of barium, and colonic anatomic abnormalities. As expected, the presence of a transition zone was most accurate in predicting Hirschsprung's disease. Eighty percent of infants with aganglionosis had a roentgen graphic transition zone. Delayed evacuation of barium was a poor predictor of aganglionosis. The presence of delayed evacuation of barium did not improve the accuracy of the transition zone to predict Hirschsprung's disease. Barium enemas did not reveal any additional colonic anatomic defects other than a transition zone to account for constipation in their study group. These results demonstrated that the barium enema is not a specific enough screening procedure to rule out Hirschsprung's disease in the unobstructed infant. Rectal suction biopsy is diagnostic and should be performed as the procedure of choice in those infants suspected of having Hirschsprung's disease.[12]

Grahamane H.H smith examined the usefulness of barium enema examination in the diagnosis and evaluation of extent of aganglionosis in the 1st year of life. Twenty-four cases of Hirschsprung's disease in children less than 1 year of age diagnosed from 1981 to 1989 were included; 17 infants had a barium enema performed. A correct diagnosis was made by barium enema in 13 of the 17 infants, with the level of transition being correctly identified in only 8. Therefore, the barium enema had a 24% false-negative rate in the diagnosis of Hirschsprung's disease and a 53% error rate in determining the level of transition. He concluded that in the investigation of an infant with a low bowel obstruction, the initial procedure suggested is a rectal washout. If this results in relief of the obstruction, it should be followed by rectal biopsy. A barium enema adds insignificant information. [13]

Although ultrasonography is not the first imaging tool for diagnosing Hirschsprung disease (HD), diagnosis is possible with real-time ultrasonography in experienced hands. Oestreich reported a case of unsuspected HD in a 1-month-old baby who was taken to a pediatrician for a check-up. A distended abdomen was noted. Ultrasonography revealed the same pattern that is observed in a barium enema examination, that is, a dilated sigmoid narrowing down to the rectum. Ultrasonography may also help in determining the dynamic or adynamic state of fluid-filled or solid-filled bowel loops. The degree of confidence is low, because gas-filled bowel loops interfere with the quality of the study and affect diagnosis.

Rectal bleeding often heralds serious colonic disease. The literature suggests that colonoscopy is superior to barium enema plus sigmoidoscopy, although no good comparative studies exist. Irvine E.J, Connor J.O and Frost R.A did a prospective Comparison of DCBE vs Colonoscopy in rectal bleeding in both children and adults. Seventy one patients with overt rectal bleeding had prospectively flexible sigmoidoscopy, double contrast barium enema and colonoscopy completed independently. The sensitivity and specificity of colonoscopy were 0.69 and 0.78 respectively for a spectrum of colonic lesions, while for combined flexible sigmoidoscopy and double contrast barium enema these values were 0.80 and 0.56, respectively. When assessing adenoma or carcinoma, colonoscopy was more sensitive at 0.82 v 0.73, while flexible sigmoidoscopy plus double contrast barium enema was superior for detecting diverticular disease. The positive predictive value for colonoscopy was 0.87 against 0.81 for flexible sigmoidoscopy and double contrast barium enema. This study confirms that colonoscopy should be a first line investigation in subjects likely to require biopsy or therapeutic intervention.[14]

Aggarwal V, Mittal S.K, Kumar N; performed a prospective study to compare the diagnostic accuracy of high quality DCBE against colonoscopy in children with overt rectal bleeding. Fourty four children underwent flexible colonoscopy and DCBE independently. The final diagnosis was made after considering all investigations. The sensitivity and specificity of DCBE were 66.66% and 100% while that of colonoscopy 74.35% and 100% respectively. When assessing polypoidal lesions of colon, diagnostic yield of enema study was 86.20% as compared to 72.41% with colonoscopy. In colitis cases, the similar figures for enema and endoscopy were 53.84% and 76.92% respectively. The study thus highlighted the utility and complementary role of DCBE and colonoscopy for evaluation of children with rectal bleeding [15].

In infants and children the most common conditions affecting the large bowel are related to obstructive or developmental abnormalities .Cancers and inflammatory bowel diseases are rare. R S Shah and H S Pikale of department of pediatric surgery in Bombay reported a case of adenocarcinoma of the colon in a 10 year old child. In this case contrast enema performed revealed a stricture at the mid-transverse colon with proximal dilatation. Considering the possibility of a tuberculous stricture the child was started on anti –TB therapy during which symptoms persisted and gradually progressed. A histological diagnosis revealed moderately differentiated mucinous adenocarcinomas. They observed that suspicious barium enema findings should be investigated further so that delay in management of such cases is prevented.[16]

Most literature suggests that conditions like intussusception could be diagnosed clinically and with ultrasonography. Richard P Shugerna did a study to identify features in the history,

physical examination, and radiological studies that were associated with the diagnosis of intussusception and to determine if there was a subset of patients being evaluated for intussusception who could be spared from undergoing a contrast enema based on a combination of history, clinical, and radiographic findings. A retrospective cohort study at a regional children's hospital emergency department was conducted. Mean age was 1.2 years among both those with and without intussusception. Predictors of intussusception in the univariate analysis included history of vomiting (P=0.02), abdominal pain (P=0.1), and rectal bleeding (P=0.003); physical examination findings of abdominal mass (P=0.001), abdominal tenderness (P=0.02), and guiac positive stool (P=0.004); and plain radiograph finding of the absence of stool in the ascending colon (P=0.05). He was unable to develop a prediction model that would reliably identify all patients with the diagnosis of intussusception. There was no reliable prediction model that can accurately identify all patients with intussusception. He recommended prospective study to aid in the development of a clinically more useful model.[17]

Nathan Kupperman HD et al performed a 5 year retrospective cross-sectional study on 145 patients below 5 years old to determine predictors of intussusceptions in young children. In this patients Contrast enema was performed because of suspected intussusceptions. They concluded that rectal bleeding, a highly suggestive abdominal radiograph, and male sex are variables independently associated with intussusception in a cohort of children suspected of having this diagnosis. Knowledge of these variables may assist in clinical decision making regarding diagnostic and therapeutic interventions.[18]

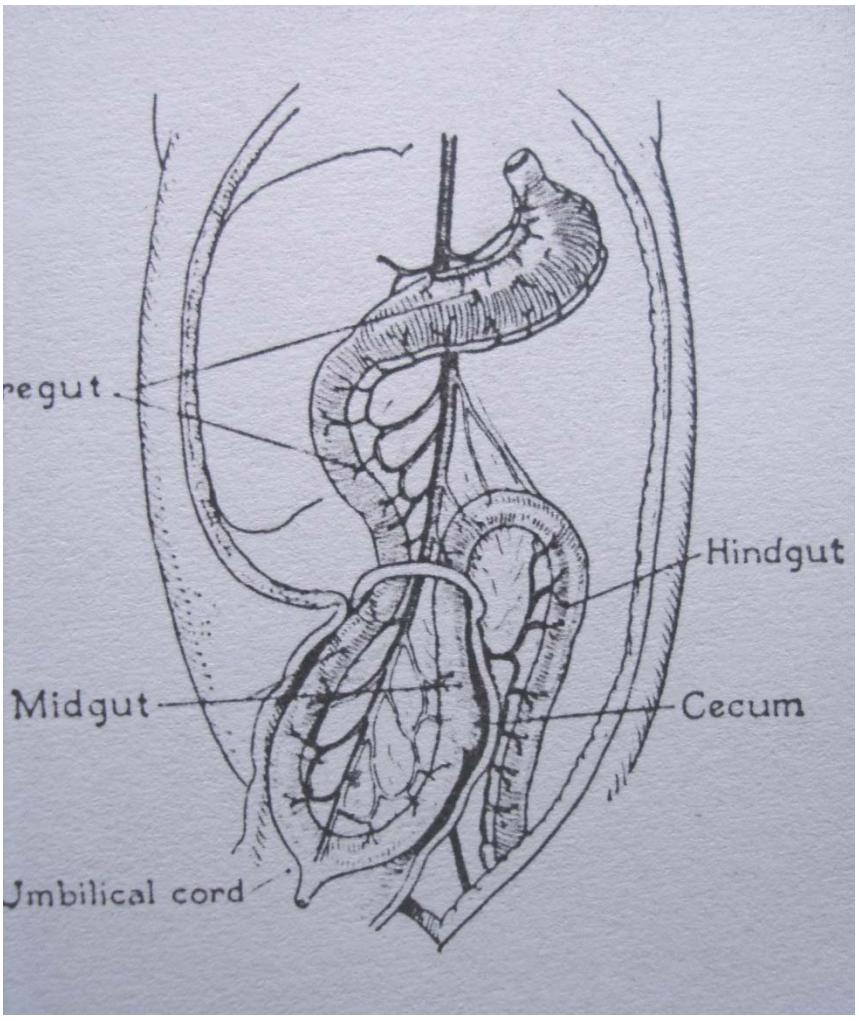
Complete contrast enema reduction of intussusception is traditionally considered successful when contrast is seen refluxing into the terminal ileum. Operative intervention is typically indicated when the intussusception is not completely reduced. Shant.S and Steven .L did a retrospective study to review the outcomes after symptomatic reduction of intussusception without requiring reflux of contrast into the terminal ileum. One hundred thirty-seven patients underwent contrast enema as the initial diagnostic/therapeutic modality. On contrast enema, 15 (10.9%) patients demonstrated reduction of the intussusception but without contrast refluxing into the terminal ileum. All 15 patients had improvement of symptoms. They concluded Nonoperative management may be used in patients with reduced intussusception despite lack of contrast refluxing into the terminal ileum if symptoms resolve [19]

Anatomy and function of the large bowel

Embryology

Embryologically large bowel develops from midgut and hindgut. Midgut gives rise to caecum, ascending colon, hepatic flexure and the right half to two thirds of transverse colon while the hindgut give rise to left third to one half of transverse colon, splenic flexure, descending colon, sigmoid colon and rectum.[20]

Figure 1



Herniated midgut as it rotates 90^0 anticlockwise

Gross anatomy

The large bowel consist of caecum, ascending colon, hepatic flexure, transverse colon, splenic flexure, descending colon, sigmoid colon and rectum. Transverse and sigmoid colon have mesentery and thus can vary in position. Ascending and descending parts are fixed [21]

The Caecum is found in right lower quadrant of abdomen. Its position is usually most variable since it is entirely enveloped by peritoneum and lies quite free in the abdominal cavity. It's a blind pouch anteriorly situated with only the omentum and abdominal wall lying over it. The terminal ileum joins it on its medial or posterior aspects. The appendix springs from the same side as ileo-caecal valve.[22]

Ascending colon lies between Quadratus Lumborum and Psoas major muscles, extending from ileocecal valve to the inferior aspect of the liver. On reaching the inferior surface of the liver it turns forwards and to the left forming the hepatic flexure. Its posterior surface is not peritonealized thus giving it a fixed position but can be radiographically mobile.[21]

The hepatic flexure is anterolateral to the descending portion of the duodenum and posterior to the thin anterior margin of the liver.

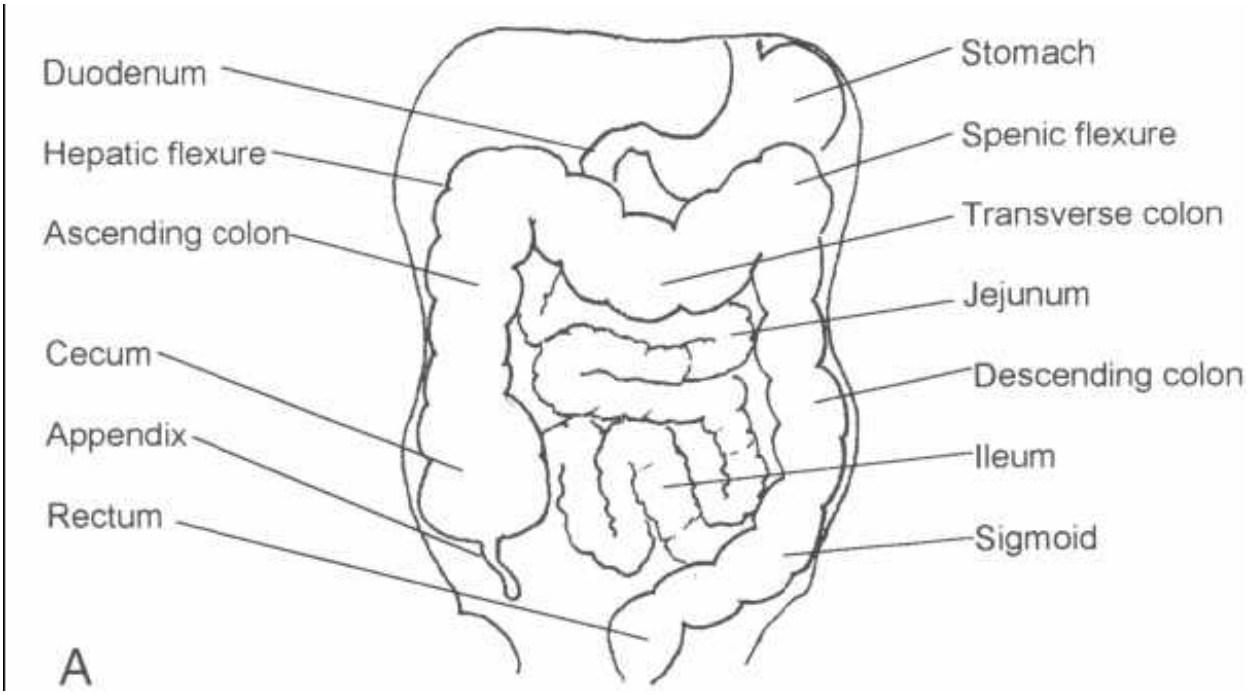
Transverse colon usually hangs down in front of the small intestines, only the greater omentum and anterior abdominal wall lie over it. It has a long mesentery hence subject to wide variation in length and position [22]

Splenic flexure is the most constant part of the colon being held in position by phrenico-colic ligament which is attached to the diaphragm at level T9-T11 posteriorly.

Descending colon is the narrowest part of the colon that extends from the splenic flexure to the sigmoid colon.

Sigmoid colon lies in pelvis minor; it has a mesentery which is attached to posterior abdominal wall to the left of midline in an inverted V – shape whose limbs divulge from the bifurcation of the common iliac vessels at sacroiliac joint.

Figure 2 (normal anatomy of the colon)



The normal colon in the newborn and young infants differs significantly in appearance from that of the older child or adult. At birth the colon is relatively elongated with redundant flexures, the sigmoid projects high, hepatic flexure slightly low and caecum may be high and retroveted.[21]

Function of the large bowel

The main function of the colon is formation, transport, and evacuation of feces. These functions require mobility, absorption of water and secretion of mucus. Caecum and ascending colon absorb water from the highly liquid material from ileum. Mucus secreted by the mucosal goblet cells protect mucosa from injury.[22]

Presenting signs and symptoms of large bowel pathologies in children.

The main presenting symptoms of large bowel abnormalities that may require radiological investigation include, failure to pass meconium for the 1st 24 – 48 hrs(for neonates), abdominal distention and constipation(infants and older children), abdominal pain , vomiting(which may be bilious) and hematochezia..[23,24]

All infants should pass meconium in the first 24–48 hrs of life. Failure to do so leads to progressive abdominal distension. Some of the conditions encountered include Hirschprung's disease, functional immaturity of the colon (meconium plug syndrome, small left colon), anorectal malformations, meconium ileus and peritonitis, and ileal atresia/stenosis. [23,24]

Constipation has been defined clinically as an alteration in the frequency, consistency, or ease of passage of stools. Causes of constipation include dietary, neurogenic, functional, tumours and drugs. The majority of constipated children have functional constipation, which is not associated with organic abnormalities. These children have normal ganglion cells and many have emotional problems. The diagnosis of constipation in children is essentially clinical, and imaging is not usually required. The plain abdominal radiograph will demonstrate the degree of faecal loading and dilatation of the large bowel however its routine use in the diagnosis of constipation is not recommended. Ultrasound can help differentiate a faecal mass from a true mass. Other imaging techniques described for the evaluation of constipation include the measurement of colonic transit time using radio-opaque markers, and fluoroscopy. These are only indicated in a highly selected group of children.[23]

Abdominal pain in neonates and infants is difficult to evaluate, but intermittent crying accompanied by flexion of thighs and defecation suggest pain of bowel origin. A preliminary scout abdominal radiograph is recommended in such cases to determine whether or not intestinal obstruction is present. This may be followed by contrast enema studies if there is evidence of low bowel obstruction [23, 24]

Vomiting is the most common symptom requiring radiological study of the infants' gastrointestinal tract[24]. In the newborn one must consider the various types of congenital obstruction. A preliminary abdominal X-ray should precede any contrast studies, if obstruction is suspected to be in the colon, then contrast enema is required[25]

For bilious vomiting, GI- obstructions are distal to the ampulla of Vater, of which malrotation and midgut volvulus constitute the common causes. Not all cases of vomiting are investigated radiologically, but there are selected cases for radiological examination.[26]

Hematochezia (Per rectal bleeding) usually indicates bleeding from the colon or from merkels diverticulum. Because low rectal lesions are more common than colonic polyps or inflammatory lesions of colon, proctoscopy to exclude anal fissures should precede radiographic studies of colon.

Large bowel pathologies

1. Neonates.

The most common problems encountered in neonates and infants are congenital in origin which include, Hirschprung's disease, Functional immaturity of the colon (meconium plug syndrome, small left colon),Meconium ileus and peritonitis, anorectal malformations, Ileal atresia. [23,25.]

Hirschprung's disease (HD)

Hirschprung's disease is a form of functional low bowel obstruction, which is due to failure of caudal migration of neuroblasts in the developing bowel. There is thus an absence of parasympathetic intrinsic ganglion cells in both Auerbach's and Meissner's plexuses in the bowel wall.

The distal large bowel from the point of neuronal arrest to the anus is aganglionic. The existence of 'skip lesions' in Hirschprung's disease is extremely unusual. In about 75% of cases, the aganglionic segment extends only to the recto- sigmoid region (short segment disease). Long segment disease involves a portion of the colon proximal to the sigmoid. Variants of Hirschprung's disease include total aganglionosis coli and total intestinal Hirschprung's disease. Ultrashort segment disease is rare and involves only the anus at the level of the internal sphincter.

The short segment disease has a male prepodence while no sex predilection is seen in the long segment.

The usual presentation in Newborns consists[10],

1. A history of delayed passage of meconium for more than 48hrs post delivery
2. Newborn constipation and abdominal distension
3. Poor weight gain
4. Poor feeding
5. Emesis/vomiting (which may be bilious)
6. Rectal examination reveals a normal anal tone and an empty ampulla

7

In infants and children clinical signs include[10]

1. Chronic constipation with absence of fecal soiling
2. Difficulty controlling bowel movements
3. Large fecal mass on abdominal palpation
4. Pellet like stool
5. Rectal examination reveals normal anal tone, empty ampulla, and explosive evacuation of fecal fluid and gas on withdrawal of finger from rectum.
6. Intermittent or complete intestinal obstruction with abdominal distension and bilious vomiting
7. Failure to thrive

Children who present later in childhood are unusual but may do so with a history of chronic constipation and failure to thrive, or rarely with an acute abdomen secondary to colonic volvulus.

The abdominal radiograph will typically show a low bowel obstruction, commonly with colonic dilatation out of proportion to the small bowel. The absence of rectal gas is one of the plain radiographic findings in Hirschprung's disease but the sign is not specific, being more commonly seen in infants with sepsis and Necrotizing Enterocolitis.

A water-soluble contrast medium enema should be performed and has a diagnostic accuracy equivalent to barium. The most important radiograph is a lateral view of the rectum during slow filling).

Barium enema is a good initial screening test for HD, the classical contrast enema findings include

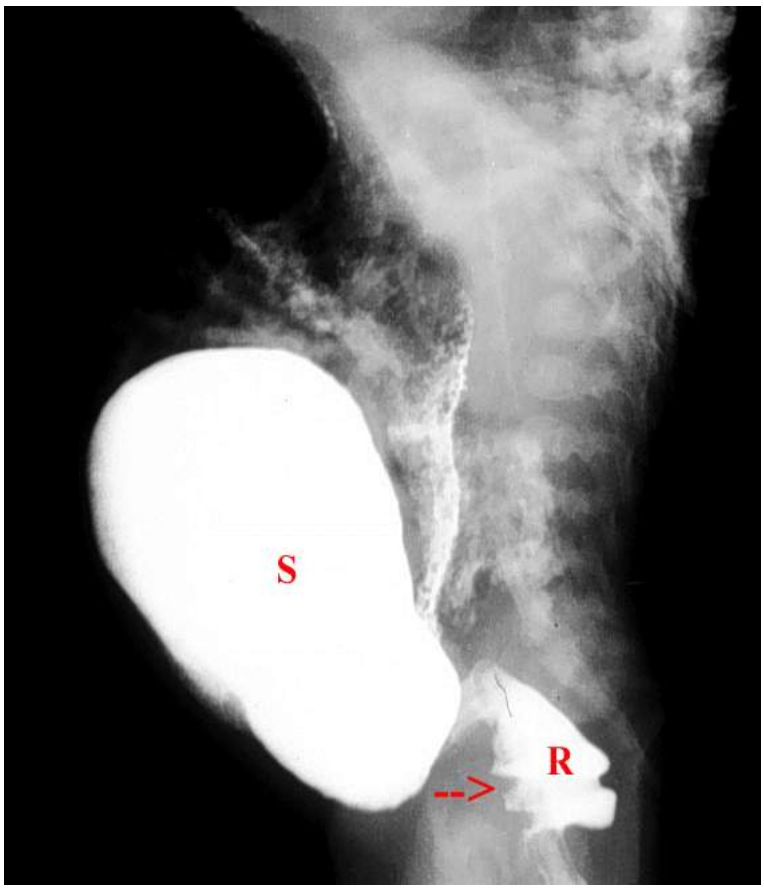
1. Aplastic distal aganglionic intestinal segment - irregular contractions may be seen in the denervated rectum
2. Dilated proximal ganglionic segment
3. Funnel shaped transitional zone.- the radiological transition zone is commonly found to be distal to the pathological transition zone
4. Retained barium 24hrs after a barium enema; however that associated with colitis evacuation may be quickly.

The diagnosis may be difficult to make during neonatal period or early infancy because there has been insufficient time for megacolon to develop. In the absence of large bowel dilatation the transitional zone may not be identified.[23, 25]

A useful calculation is the recto: sigmoid ratio; the rectum should always be the most distensible portion of the bowel and have a diameter greater than that of the sigmoid colon (recto: sigmoid ratio > 1). In short segment disease this ratio is reversed.[22]

The radiological features of Hirschprung's disease may be absent in the neonate and overall the contrast medium enema has a false-negative rate of 20–30%.

Figure 3



Barium enema shows contracted rectum, transitional zone, and dilated sigmoid colon.

Functional immaturity of the colon

Immature left colon (meconium plug syndrome or small left colon) is a relatively common cause of neonatal bowel obstruction.

Prematurity, birth by caesarean section, maternal diabetes and drug ingestion, as well as treatment of mothers with magnesium sulphate during labour have all been reported as risk factors to infants[26]

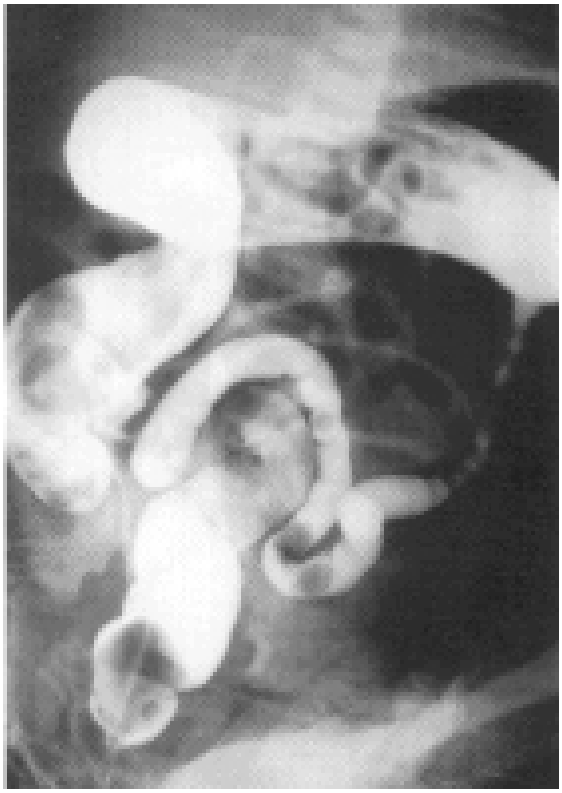
The affected infants present with symptoms and signs of bowel obstruction, though they tend to be less ill than those with mechanical obstruction; the abdomen is less distended and vomiting is not necessarily a prominent feature. There is delayed passage of meconium.

The plain radiograph shows distension of both small and large bowel loops to the level of the inspissated meconium plugs. Few fluid levels are seen.

The contrast medium enema typically shows a microcolon distal to the splenic flexure, at which point there is an abrupt transition to a mildly dilated proximal colon (this differs from Hirschprung's disease in which the transition zone is more gradual and which is uncommon at the level of the splenic flexure)). The rectum is usually distensible in the patient with functional immaturity of the colon and consequently the recto-sigmoid ratio is normal. Discrete plugs of meconium are seen as filling defects in the dilated colon. In the premature infant, the whole colon may be small

When performed with water-soluble contrast medium, the enema is not only diagnostic, but therapeutic. A variable amount of meconium is typically passed soon after the examination, with a gradual recovery of the infant over the next few hours or days. Bowel perforation has occasionally been reported

Figure 4



Contrast enema shows microcolon distal to the splenic flexure .The transition point is abrupt

Meconium ileus

It is a form of distal intestinal obstruction caused by inspissated pellets of meconium in the terminal ileum. The meconium desiccates in the terminal ileum and becomes impacted, causing a high grade obstruction. A functional microcolon results.[23]

The presenting clinical symptoms and signs of noncomplicated meconium ileus are vomiting, abdominal distension, and failure to pass meconium.

The contrast medium enema in meconium ileus demonstrates a virtually empty microcolon. Reflux of contrast medium into the terminal ileum will show that it too is small in caliber and numerous pellets of meconium are outlined

Anorectal malformations (imperforate anus or anorectal atresia)

The condition results from failure of descent and separation of the hindgut and the genitourinary tract during the second trimester. The abnormality consists of anorectal atresia, with or without an anomalous connection between the atretic anorectum and the genitourinary tract.

Infant should be clinically assessed to determine whether the lesion is a low or high one

The traditional radiological approach to the baby with imperforate anus is prone plain abdominal radiograph.

Contrast enema (colostogram) is used to identify the lesion and any direct complications e.g fistulas.

Transperineal US has been used to measure the distance of the rectal pouch from the perineum

Colon atresia

The right colon is most commonly affected. The atresia may take the form of a diaphragm or web, fibrous cord or mesenteric gap defect, with the latter occurring most frequently. Colon atresia is thought to be due to an in utero vascular accident

The abdominal radiograph will show the features of a low intestinal obstruction. If multiple atresias are present, then the bowel will be distended only to the level of the most proximal atresia, giving a misleading initial abdominal radiograph.

A contrast medium enema usually demonstrates a distal microcolon, with obstruction to the retrograde flow of contrast medium at the point of the atresia. If a colonic diaphragm or web is present, then the column of barium may terminate in a ‘wind sock’ configuration, as the obstructing membrane balloons into the proximal air-filled colon.[22, 25]

Figure 5

Enema outlines the colon junction where it abruptly ends in a case with colonic atresia

2. Infant and children large bowel pathologies.

The pathologies include

1. Bowel obstruction – intussusception, volvulus
2. Polyps and polyposis syndromes
3. Inflammatory – inflammatory bowel disease
4. Infestations – ascaris lumbricoides
5. Tumours - rare

Intussusception

Intussusception is a common surgical emergency in infants and young children. It consists of a telescoping of a segment of bowel (intussusceptum) into a more distal segment (intussuscipien).[23.]

The majority of children are under 1 year of age, with a peak incidence between 5 and 9 months of age. Ileocolic intussusceptions are the most common type. Ileo-ileocolic, ileo-ileal, and colocolic are much less common. Most (over 90%) have no lead point and are due to lymphoid hypertrophy, usually following a viral infection. Pathological lead points (which include Meckel's diverticulum, intestinal polyp, duplication cyst, and lymphoma) occur in 5–10% of patients[23]

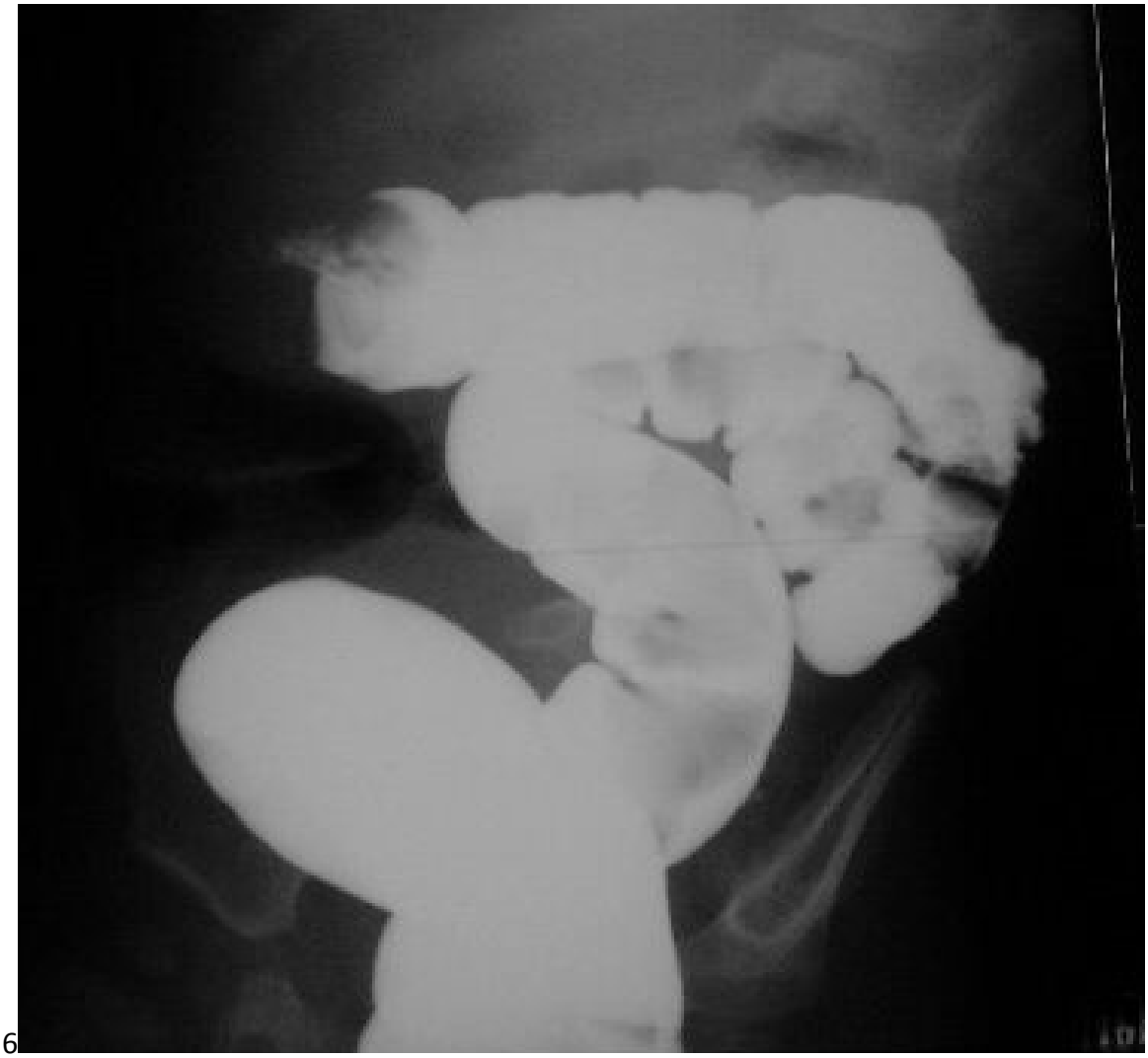
The classic triad of intermittent colicky pain, vomiting and bloody stools full of mucus (carrent jelly stools) is seen infrequently (20%), often infants present with 2 symptoms [26.]

Supine abdominal radiograph findings include the presence of a soft tissue mass, distal small bowel obstruction, absence of gas from the colon, difficulty in assessing the position of the caecum, or pneumoperitoneum. Abnormal radiolucencies in the soft tissue mass are due to mesenteric fat trapped in the intussusception. The abdominal radiograph may be normal in over 50% of cases of intussusception [28.]

Barium, water soluble contrast media, water, electrolyte solutions or air may be used with radiographic or ultrasound guidance to diagnose and reduce intussusception.

Intussusception has 2 classical signs on barium. The meniscus sign produced by the rounded apex of the intussusceptum protruding into the column of contrast material and coiled appearance caused by the edematous mucosal folds of the returning limb of the intussusption outline by the contrast [29]

Figure



6

Barium enema shows a cup shape filled defect

Inflammatory bowel disease

Inflammatory bowel disease (IBD) presents in childhood in approximately 25% of cases. The aetiology of IBD in children includes ulcerative colitis, Crohn's disease, infective colitis, typhlitis and radiation enteritis. Investigation is similar to adults. US has a greater role in children as bowel imaging is easier . Thickened bowel is the typical finding, but is non-specific. Most children with IBD present with weight loss and diarrhoea. Crohn's disease may present at any age, often with failure to thrive, abdominal pain, and chronic low grade fever, in addition to the usual symptoms. Endoscopy and barium studies will diagnose most cases of childhood Crohn's disease. Further imaging with US and radionuclide studies with labelled white cells may be required if endoscopy and barium studies are negative and there is strong clinical suspicion,

although CT can be unreliable in the proximal bowel. CT is useful for demonstrating abdominal abscesses. Gadolinuim-enhanced MRI has also been described in the diagnosis of IBD, though it is not used routinely.[23]

Polyposis syndromes

Intestinal polyposis syndromes are rare in children. They are more commonly found in adult life.They include familial polyposis coli and juvenile polyposis coli, Most have an autosomal dominant mode of inheritance and many have a significant risk of malignancy. The colon is predominantly affected in polyposis syndromes.

Presentation is in the first decade of life, most often between 4 and 6 years of age. Rectal bleeding is the usual presenting complaint; anaemia, intussusception, and rectal prolapse can occur.

Double contrast GI studies are the gold standard radiological methods for diagnosis. US and MRI can demonstrate polyps and could be used for follow-up, but polyps less than 1.5 cm in diameter may be missed on MRI and clusters of polyps may be seen as a mass lesion.[23]

Gastrointestinal tumours

Gastrointestinal tumours are rare in children. Endoscopy may diagnose tumours in the upper GI tract and large bowel. Presentation may be with gastrointestinal bleeding, anaemia, and abdominal pain. The neoplasm can act as a lead point for intussusception. Imaging is by double contrast medium barium enema, small bowel series, and/or CT.

Lymphoma is the most common primary malignant intestinal tumour in childhood. Involvement of the bowel and mesentery is almost always caused by non-Hodgkin's lymphoma and is rare in Hodgkin's disease.

It is usually found in the ileocaecal region and may present with abdominal pain, mass, bowel obstruction, weight loss, or intussusception.

US is useful for initial imaging. CT is required for staging; it can identify tumour in the bowel wall and may show additional disease in the abdominal lymph nodes, liver, spleen, or kidneys.

Barium studies may show strictures, obstruction, mass lesions, or ulceration [23]

JUSTIFICATION

The goal of imaging is to provide a diagnosis and other relevant information to the clinician while minimizing patient discomfort and radiation exposure.

The current gastrointestinal imaging modalities in use include Plain radiography, sonography, fluoroscopic contrast studies, CT, MRI, radionuclide scanning and angiography. Plain radiography and fluoroscopic contrast studies are traditional conventional methods, while ultrasound, CT, MRI and radionuclide scanning are new imaging modalities.[33]

Ultrasound is generally well tolerated by babies and children but it's highly operator dependent and limited by acoustic shadowing from bowels and small field-of-view. With plain radiograph, the gastrointestinal organs cannot be separately visualized. MRI and CT are useful for clarification of status of surrounding organs of an already identified pathology, thus plays a role in disease staging especially where cancer is involved.[34]

Contrast enema examination still remains an important diagnostic imaging modality in the examination of large bowel pathologies in children. As it has been alluded to in the literature review, contrast enema is sensitive in detecting large bowel congenital anomalies in neonates and young infants and is relatively inexpensive.

A study evaluating the role of contrast studies to evaluate large bowel disease in children has not been undertaken in Kenya. The findings from the study will assist the clinician make appropriate investigating decisions in the management of the large bowel pathologies.

OBJECTIVES

BROAD OBJECTIVES.

To determine the role of contrast enema in diagnosis of large bowel pathologies in children aged twelve years and below at KNH.

SPECIFIC OBJECTIVES

1. To establish the different indications for the contrast enemas in children

2. To show the disease pattern in children undergoing the contrast enema examination at KNH

3. To determine age and sex distribution of common pathologies

4. To compare the contrast enema diagnosis with clinical data on request forms in order to determine the relation if any.

5. To study the sensitivity and specificity of barium enema in the common large bowel pathologies in children.

Hypothesis

Contrast enema examination is of diagnostic value in evaluating the large bowel disease in children.

RESEARCH ASSUMPTIONS

The following are the research assumptions, which will inform the study:

1. All children with large bowel pathologies or suspected to have large bowel pathology get contrast enema studies

2. Every child who undergoes contrast enema studies is suspected to have large bowel pathology.

3. Most of the contrast enema exams done on pediatric patients at KNH are appropriate and yield useful information for diagnosis of the patient's illness

4. Pediatric patients who undergo contrast enema studies at KNH are adequately screened by clinicians and radiologists.

RESEARCH QUESTIONS

The following are the research questions based on the above assumptions.

1. Is contrast enema of value in large bowel pathologies in children?

2. What percentage of contrast enemas done on pediatric patients yield useful information for diagnosis of the patient's illness?

3. Do the request forms for contrast enemas for pediatric patients at KNH have adequate clinical information

SCOPE OF THE STUDY

This study investigated the role of contrast enemas in the diagnosis of large bowel pathology in children aged 12 years and below at KNH during the 12 months period between November 2009 and November 2010.

STUDY AREA

The study was conducted at radiology department of Kenyatta National Hospital.

STUDY POPULATION

The study population considered all children who underwent Contrast enema examination at Kenyatta National Hospital to evaluate suspected large bowel pathology

STUDY DESIGN:

This was cross sectional descriptive study.

SAMPLE SIZE DETERMINATION

At confidence interval of 95% and a margin error of 5% and prevalence rate of the most common condition diagnosed by contrast enema being at 6.4% the sample size was calculated by the formula:

$$\mathbf{n} = \frac{z^2 p(1-p)}{d^2}$$

Where**:**

N = The desired sample size.

P = The Proportion in the target population estimated to have characteristics being measured

Z = the standard normal deviate at the required confidence level.

d =the level of statistical significance set.

When this formula is applied at d = 0.05, z = 1.96, and d = 6.4 %

$$N = \frac{(0.064)x(0.934)(1.96)^2}{(0.05)^2}$$

n = 92 patients

the actual sample size was 92 subjects that was evaluated in the proposed twelve months of the data collection

SAMPLING METHOD

Convenience sampling was used. All the contrast enemas of children aged 12 years and below whose parent/guardian consented and underwent enema examination at KNH were included in the study, until the desired sample size of 92 patients was achieved.

INCLUSION

All children aged 12yrs and below who underwent contrast enema examination at KNH and whose parents/guardian gave consent.

EXCLUSION CRITERIA

Patients whose parent/guardian declined participation in the study.

CONTROL OF BIAS

All patients attended to during this period were included except if the parent/guardian declined participation. The enema examination was conducted by the researcher in collaboration of consultant Radiolologist.

STUDY LIMITATIONS

Some patients were unable to undergo further investigations to determine proof of diagnosis made on contrast study.

A few patients, especially those diagnosed as normal on contrast enema failed to turn up in clinic for review/follow up to ascertain whether symptoms had subsided or not.

Inadequate of patient information and inaccessibility of plain films results was a hindrance.

ETHICAL CONSIDERATION

This study was conducted with due regard for patients rights and confidentiality. The patient's names were not used in the study in order to maintain confidentiality.

Before commencement of this study, the proposal was submitted to the ethical committee of KNH for approval

The results obtained from this study was treated with confidentiality and results used for academic and clinical improvement purposes only ,and to this end the results will be submitted to KNH ethical committee to assist them form a database for future study and reference.

MATERIALS AND PROCEDURES

All barium enema examinations of consenting patients who met the inclusion criteria were studied consecutively for the period from November 2009 to November 2010.

Enema was performed using either barium sulphate or iodinated water soluble contrast on Philips fluoroscopy machine diagnoset 15 manufactured in 1992

All the contrast enema radiographs of patients done during the study period were retrieved/obtained from department of radiology and pediatric outpatient clinic.

The patient's biodata, clinical history and other tests done prior to enema were recorded

The principal investigator participated in the examination with a qualified radiologist on duty for the day for the subjects obtained prospectively. He also retrieved radiographs of patients done 4 months in retrograde for analysis.

The radiological diagnosis was arrived at after discussion with the qualified radiologists most of whom have had over 5 years of experience as radiologists and perform various fluoroscopic examinations during their day to day duties.

In case of varying opinion, or indeterminate diagnosis a second and 3rd radiologists were approached for their opinion before a final diagnosis was settled upon.

The proof for a certain radiological diagnosis where possible was determined by other methods e.g biopsy, surgical exploration and serological.

The results of these tests were interpreted independently of barium enema findings to avoid bias.

A specifically designed data collection form was used to record demographic details, clinical findings and clinical impression of the patients. Also recorded were the findings of the contrast enema examinations. The data thus collected was analyzed in line with the objectives of the study. The results are presented in form of tables, charts and graphs.

DATA AND RESULTS INTERPRETATION

RESULTS

Introduction

This chapter presents the results of the study conducted between November 2009 and November 2010 among 92 children undergoing contrast enema studies at KNH.

Statistical package for social sciencies (SPSS version 15.5) program was used in data processing with the help of a statistician.

The findings are organized according to the study objectives and presented under the following five sections:

a) Indication of contrast enemas in children

b) Age and sex distribution of common large bowel pathologies in children

c) Disease patterns in children undergoing contrast enema studies at KNH

d) Comparison of contrast enema diagnosis and clinical data

e) Sensitivity and specificity of barium enema for large bowel pathologies

Indication for contrast enemas in children

Table 1 shows the common presentation among children for whom contrast enema studies were requested at KNH. The most common presentation symptom in children with large bowel pathologies was constipation in 39.4% (n=36) of patients followed by delayed meconium passage in 28.3% (n=26) of patients. The other common presentation were abdominal distention (n=16, 17.4%) and abdominal pain (n=15, 16.3%). No patient in this sample presented with an abdominal mass or per rectal bleeding.

Table 1: Presenting complaints among 92 children with large bowel pathologies in KNH

Presentation	Frequency (n)	Percent*
Constipation	36	39.3
Delayed meconium passage	26	28.3
Abdominal distention	16	17.4
Abdominal pain	15	16.3
Failure to thrive	7	7.6
Diarrhea	5	5.4
Vomiting	3	3.3
Other presentation	8	8.1

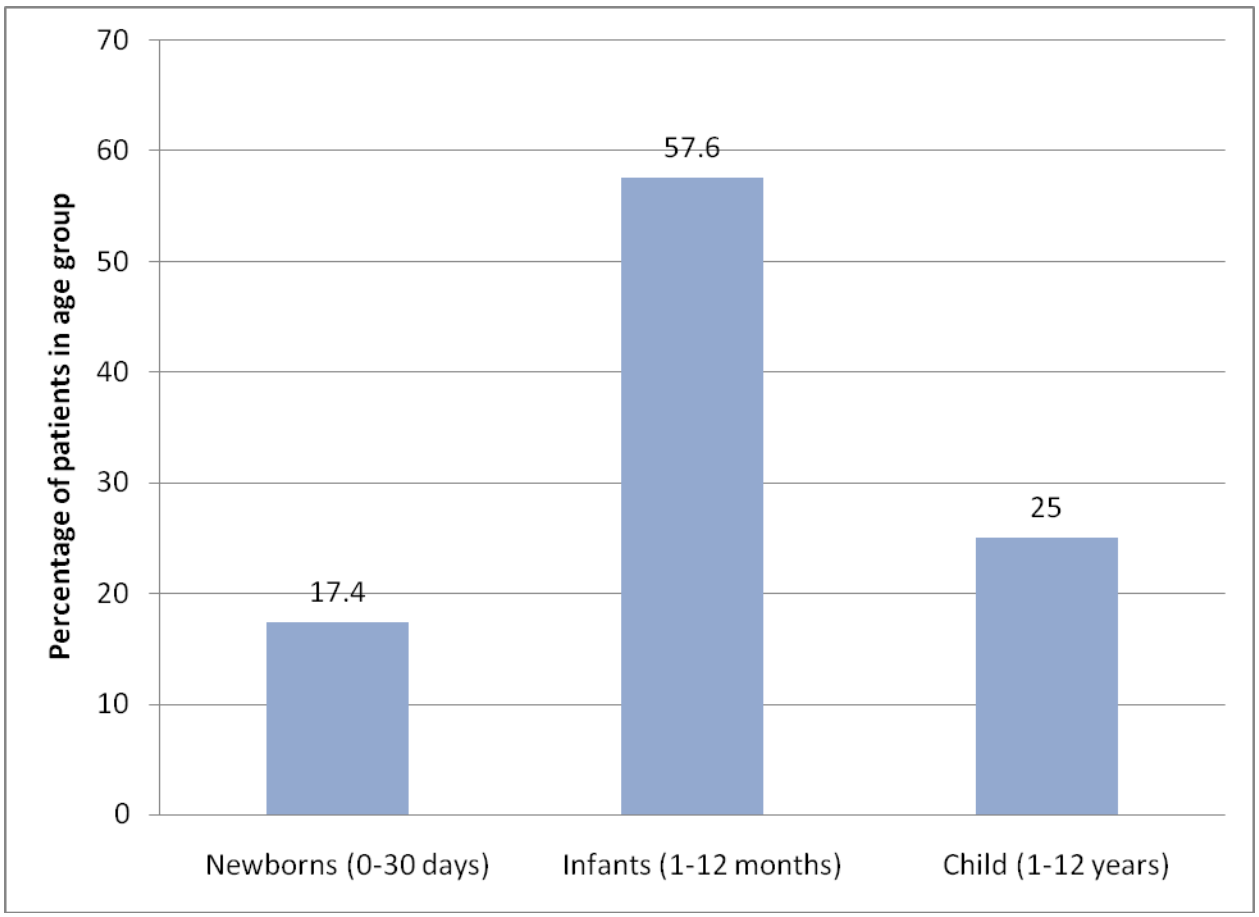
*Proportions sum to over 100% because patients commonly presented with more than one complaint

Age and sex distribution of common large bowel pathologies in children

Age distribution

Figure 7 shows age distribution of the 92 children in the study who had symptoms of large bowel disease and underwent contrast enema studies. More than one-half (57.6%, n=53) of the children were infants and a further 25% (n=23) of the studied children were aged between 1 and 12 years of age. Newborn represented 17.4% of all children with large bowel pathologies. The main presentation of large bowel problems among newborns was delayed meconium passage. In fact, 11 (68.8%) out of the 16 newborns studied presented with this problem.

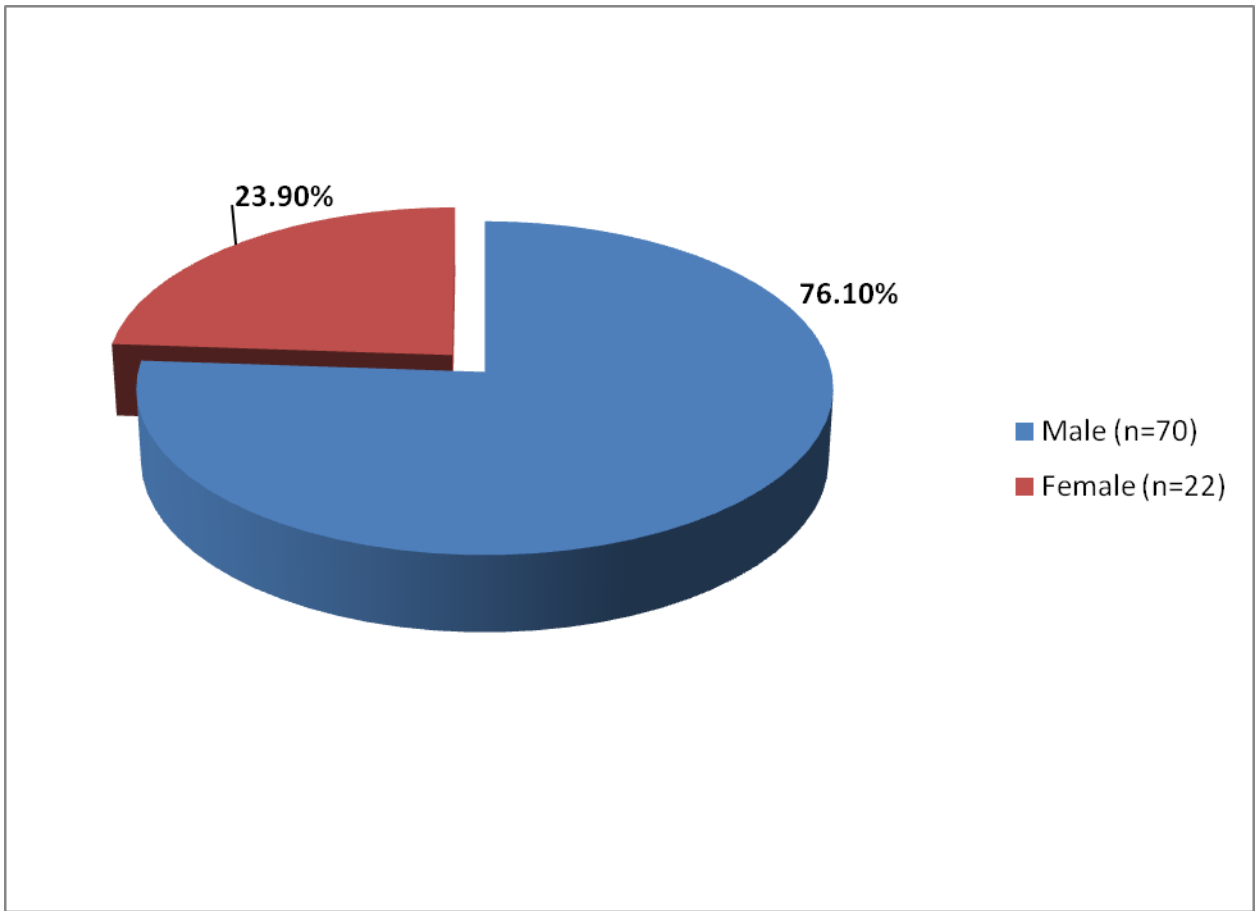
Figure 7: Age distribution of children with large bowel pathologies at KNH



Sex distribution

As shown in Figure 8, the study sample consisted of 70 males (76.1%) and 22 females (23.9%) (Male: female ratio 3:1). The male and female patients were similar in terms of important demographic characteristics e.g. for age male patients had a similar age distribution to that of female patients, $p = 0.94$. The clinical presentation of males and females were also similar implying no specific presentation was more common among children of a given gender.

Figure 8: Percent distribution by gender of children with large bowel pathologies at KNH



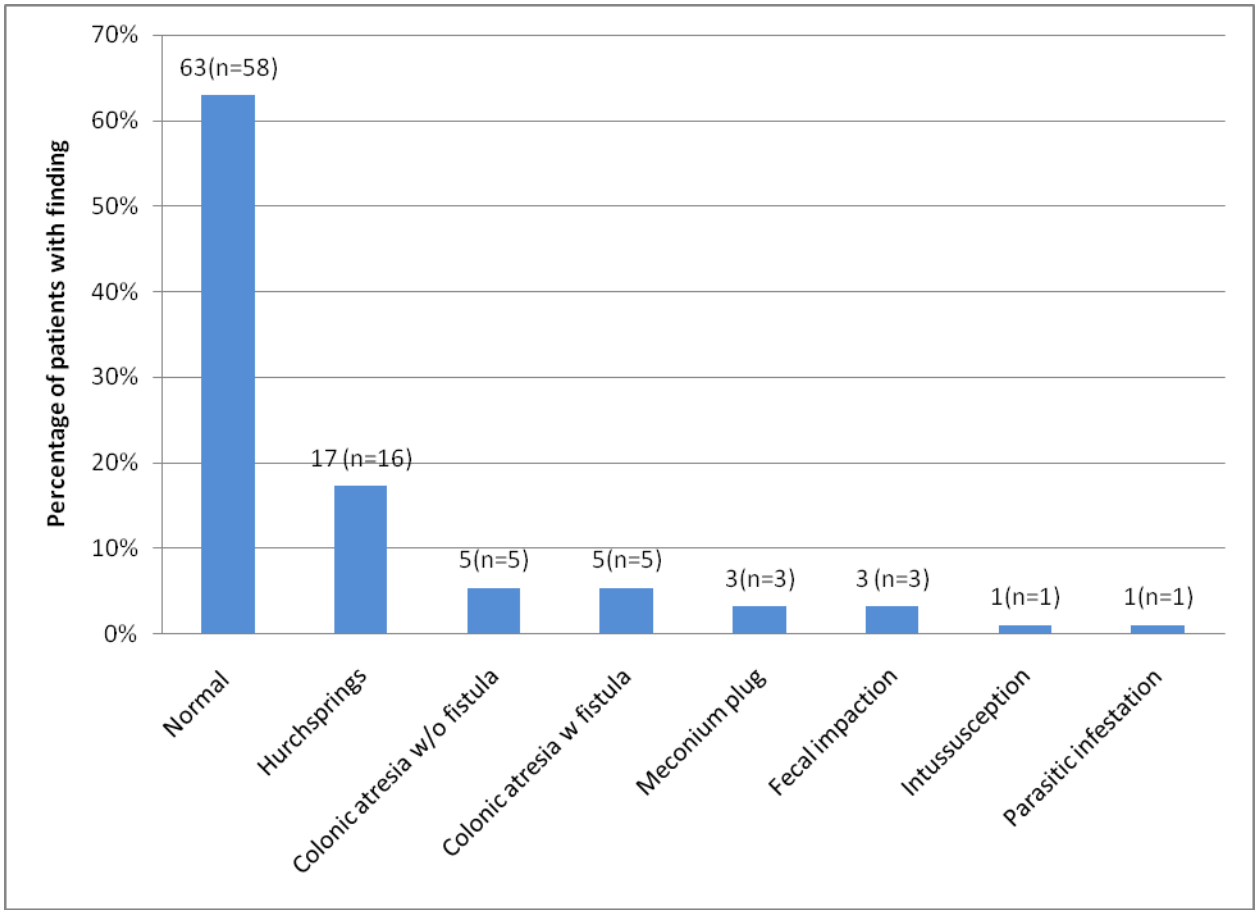
Disease pattern in children undergoing contrast enema examination at KNH

A total of 92 contrast enema studies were conducted among 92 children included in the analysis. These studies were conducted using two types of contrast medium namely: barium sulphate in 87% of the patients and iodinated water soluble contrast in the remaining 13% of patients. Apart from the contrast enema studies 23 (25%) children had additional imaging studies done including either an ultrasound (10.9%, n=10) or an abdominal X-ray (14.1%, n=13).

The patterns of disease established using contrast enema findings among the 92 children were as follows: Sixty-three percent (n=58) of the children had normal contrast enema films. The remaining 37% (n=34) patients had abnormal findings.

These findings based on contrast enema diagnosis are presented in Figure 9 below.

Figure 9: Contrast enema findings among 92 children investigated in KNH



The most commonly reported pathology was Hirschsprung's disease which was diagnosed among 17.4% (n=16) children who underwent contrast enema studies (Figure 9). This was followed by colonic/anal atresia diagnosed among 10 children (10.8%) in total. Colonic/anal atresia with fistula and colonic/anal atresia without fistula had a similar prevalence in this sample with each diagnosis accounting for half (5 out of 10) of the total colonic/anal atresia diagnoses

that were identified. Other diagnoses that were seen included meconium plug (3.3%), fecal impaction (3.3%), intussusceptions (1.1%) and parasitic infestations (1.1%)

Contrast enema diagnosis and demographic characteristics

As shown in Table 1, the distribution of age and sex was similar in both samples of children with a diagnosis of Hirschsprung's disease (n=16) and those without the disease (n=76). Out of the 16 children with Hirschsprung's disease 3 (18.8%) were female and 13 (81.2%) were males, giving a male: female ratio of 4: 1.

Similarly, 25% (n = 4) of 16 cases of Hirschsprung's diseases occurred among newborns and 62.5% were infants. Among the 76 children without Hirschsprung's disease, 15.8% were newborns, and 56.6% were infants. These differences in proportions of children with and without Hirschsprung's disease across different age groups were not statistically significant, chi square =0.19(2), p = 0.38.

Table 1: Hirschsprung's disease diagnosis and demographic characteristics

	Hirschsprung's disease			
	Yes	No		
	n (%)	n (%)	Chi square	P value
Age	16	76		
Newborns (0-30 days)	4(25%)	12(15.8%)	0.19(2)	0.38
Infants (1-12 months)	10(62.5%)	43(56.6%)		
Child (1-12 years)	2(12.5%)	21(27.6)		
Sex				
Male	13(81.2%)	57(75%)	0.28(1)	0.75
Female	3(18.8%)	19(25%)		

Ten (10.9%) out of the 92 children studied had a diagnosis of colonic/anal atresia on contrast enema. Five (5.4%) of these diagnoses were colonic/anal atresia with a fistula and the remaining 5 (5.4%) were colonic/anal atresia without fistula. There was no case of colonic atresia among

neonates. Only a single case (10%) of atresia was diagnosed among the children aged 1 to 12 years (Table 2). All the remaining cases (90%) of colonic atresia diagnoses occurred among infants. Results of the chi square test found no significant association between age of children and occurrence of both colonic atresia with fistula and colonic atresia without fistula, chi square = 5(2) p=0.08. The gender of patients was not significantly associated with diagnosis of colonic fistula. As shown in Table 2, 60% of colonic atresia were diagnosed in males while the remaining 40% occurred among females, p=0.24.

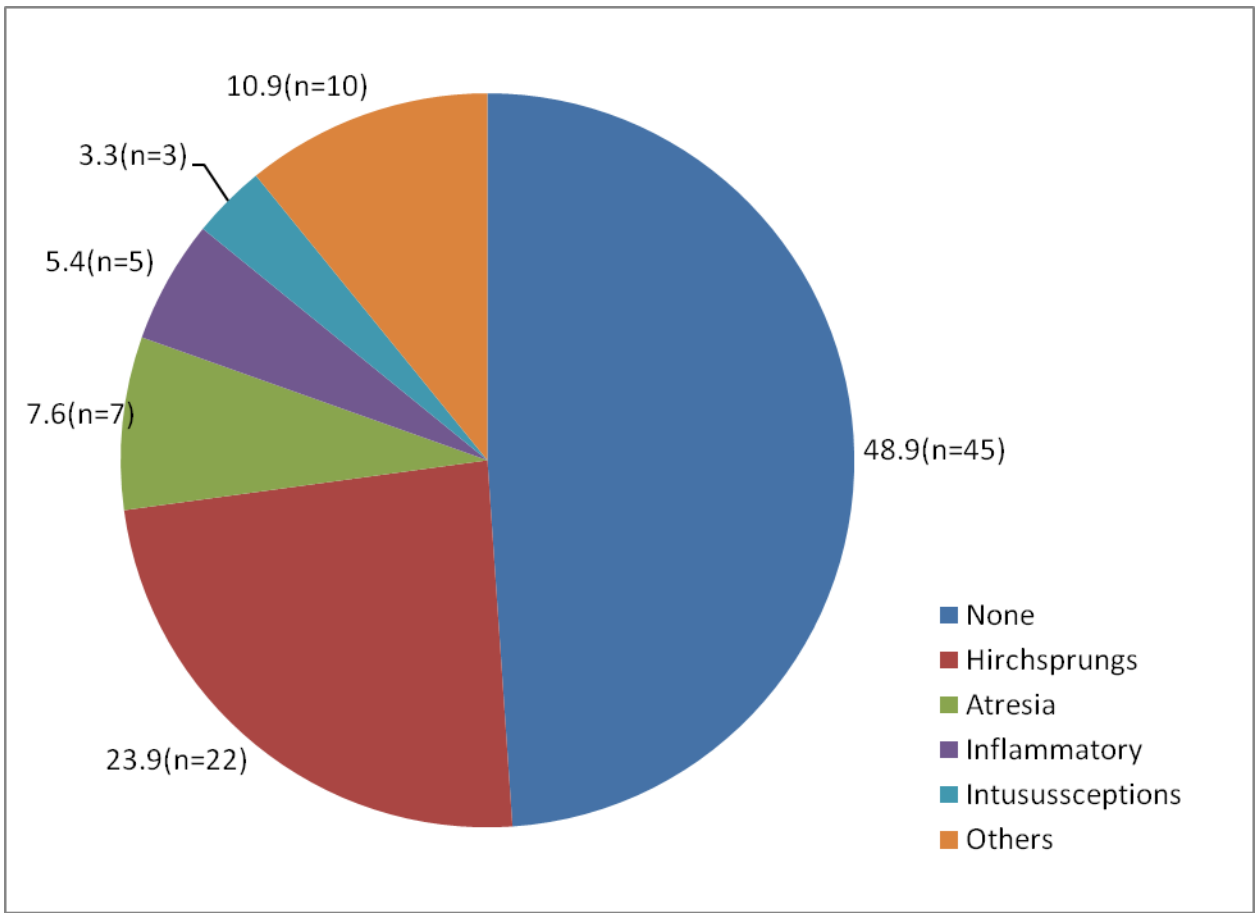
Table 2: Colonic atresia diagnosis and demographic characteristics

	Colonic atresia			
	No	Yes		
	n (%)	n (%)	Chi square	P value
Age	82	10		
Newborns (0-30 days)	16(19.5%)	0(0)	5.0(2)	0.08
Infants (1-12 months)	44(53.7%)	9(90.0%)		
Child (1-12 years)	22(26.8%)	1(10.0%)		
Sex				
Male	6(60.0%)	64(78.0%)	0.56(1)	0.24
Female	4(40.0%)	18(22.0%)		

Comparison of contrast enema diagnosis and clinical data

Figure 10 presents the number and proportion of patients who had different clinical impressions as part of the clinical information provided in their request forms. Most (48.9%) of the patient did not have a clinical impression indicated in their request forms by the clinicians ordering for contras enemas. On this requests only the presenting complains were entered.

Figure 10: Clinician impressions recorded on contrast enema request forms for 92 children with suspected large bowels pathologies.



Out of the 45 children for whom clinicians ordered a contrast enema without indicating a clinical impression, 34 (75.6%) had normal contrast enema films. On the other hand, 6(13.3%) had Hirschsprung's disease, 2 (4.4%) had colonic atresia and the remaining 3 children had intussusceptions (n=1), fecal impaction (n=1) and parasitic infestation (n=1).

Table 3 compares contrast enema findings with the initial clinical impression among the remaining 47 children who had a clinical impression indicated in their contrast enema request forms. From the diagnoses presented in the Table 6 the diagnoses with the highest percentage agreement between clinical and contrast enema finding was Atresia. For this diagnosis all the 7

patients with a clinical impression of the condition were confirmed to have either rectal atresia with fistula (71.4%) or rectal atresia without fistula (28.6%) when contrast enema was performed. This was followed by Hirschsprung's disease where 45.5% of patients with a clinical impression of the condition were confirmed to have it based on the contrast enema findings. All the patients suspected to have intussusceptions (n =3) or inflammatory conditions (n =5) had normal contrast enema findings (Table 3).

Table 3: Findings of contrast enema versus clinical impression of large bowel pathology among 47 children with a clinical impression indicated on their request forms

	Contrast enema finding						
Clinical impression	Hirschsprung's	Meconium plug	Fecal impaction	Colonic atresia w fistula	Colonic atresia w/o fistula	Normal	Total
Hirschsprung's	10(45.5)	2(9.1)	-	-	1(4.5)	9(40.9)	22(100)
Atresia	-	-	-	5(71.4)	2(28.6)	-	7(100)
Inflammatory	-	-	-	-	-	5(100)	5(100)
Intussusceptions	-	-	-	-	-	3(100)	3(100)
Others	-	1(10)	2(20)	-	-	7(70)	10(100)
Total	10(21.3)	3(6.4)	2(4.3)	5(10.6)	3(6.4)	24(51.1)	47(100)

Sensitivity and specificity of contrast enema diagnosis of large bowel pathologies

The sensitivity of contrast enema was calculated using biopsy results as the gold standard Biopsy studies and surgical findings were available for 16(17.4%) and 11(12%) patients, respectively, out of the 92 patients who underwent contrast enema studies. The findings of biopsy are presented in Table 4 below.

Note that the surgery done was either colostomy diversion or corrective surgery of the problem.

Table 4: Findings among children who underwent biopsy for suspected large bowel disease at KNH

	Frequency (N)	Percent (%)
Biopsy Findings		
Agangliosis	13	14.1
Normal	3	3.3

The most common finding on biopsy was agangliosis reported in 13 (14.1%) patients. Out of the 13 children with a biopsy finding indicative of agangliosis, 12 were correctly identified by contrast enema giving a sensitivity of 92.3%. Only one case of the 6 patients suspected clinical to be having Hirschsprung and enema reporting normal, turned up to be aganglionosis on eventual biopsy result. Giving a specificity of 83.3 % for this particular condition.

DISCUSSION

Radiological imaging is an important part of the evaluation and management of children with suspected large bowel anomalies. Clinical presentation is often non-specific, commonly with abdominal distension, delayed passage of meconium and constipation for which the underlying cause may or may not be clinically apparent.

In a good proportion of patients, the clinical assessment alone may suffice in providing the diagnosis e.g in cases of anal atresia, though still imaging is required to evaluate the level of atresia and presence/absence of fistula.

Contrast enema is a common investigation requested by the clinician to evaluate large bowel pathology in children

The most common presenting symptoms in this study were constipation (39.3%) and delayed passage of meconium (28.3%). This compares well to a local study done by Onyango[10] to assess cases of hirshsprungs which quotes the symptoms to be present in 35 % and 22 % respectively. However R Y Kanterman et al in their evaluation of 19 signs and symptoms in 471 pediatric patients referred for barium enema examinations, to determine predictors of an abnormal study found out that abdominal pain(48%), constipation(27%) and tenderness(25%) constituted the common presenting signs and symptoms

Fifty eight patients (63%) were found to have normal enema findings. A similar finding of (66.8%) was reported in a local study by Ondeko[9] in which he was evaluating the value of contrast enema in both Children and adults. In both studies most of the normal findings could be traced to requests which did not have a clinical impression and those with 'rule out' requests. In this study such cases accounted for 48.9%.

Only one (1) patient of those who were reported as normal, on follow up in clinic was found to have persistence of symptoms. Biopsy done on the patient showed that the infant had aganglionic segment.

This false negative case can be explained by the fact that the patient was a neonate at the time and may not have developed the typical radiographic findings normally seen on enema e.g dilatation of sigmoid and development transitional zone. This phenomenon is well explained in most of the literature [14 25 30]

As expected the congenital lesions formed the highest percentage of the large bowel pathology as seen in this study at Kenyatta National Hospital. The clinicians accuracy in diagnosing aganglionosis and anal-rectal malformations were 57% and 100% respectively

Barium enema examination had a high sensitivity (92%) and specificity (83.3%) rates in the diagnosis of Hirshsprungs disease. This correlated well with two previous local studies carried out at Kenyatta National Hospital by Ondego[9] and Onyango [8] which put the sensitivity at 96% and 67% respectively.

There was 1 false positive . On further review the false positive case was traced to a 3 yr boy whose diagnosis of aganglionosis had been made mainly due to the delayed evacuation of barium and what had appeared as a relatively dilated sigmoid colon. As reported by Taxman et al, delayed evacuation of barium is a poor predictor of aganglionosis and does not improve the accuracy of predicting Hirschsprung disease.

The male to female ratio of proven cases of aganglionosis was 3:1, which compares well with work done by Onyango in his review in management of hirschsprungs disease at KNH for a period of 10 yrs. Studies by Taximan and Grahamane quoeted a similar male: female ratio of 2: 1 and 3:1 respectively.

Two (2) patients with diagnosis Hisrchsprungs disease also had features of Down syndrome. This associtiation is well documented in literature [11, 23, 26]

Ano-rectal malformation is a clinical diagnosis, though by perfoming a colostogram one can estimate the level of the obstruction and presence of fistula. Literature quotes most of the ano-rectal malformations to be associated with fistula. [19, 22]. In this study the number of patients with fistula was equal to those without fistula though the sample size (10) was too small to derive a statistically significant conclusion.

Most literature reports that distinction between high and low ano-rectal malformation to be radiographically difficult and most are assumed from the type of fistula present.

Patients with a high (rectovesical /rectovaginal) fistula are considered to have a high malformation while those with low (rectocutanous) fistula to have a low malformations [19, 22.] This study shows that contrast enema is only of value to shoe the presence and type of anomalous fistulous communication, but cannot reliably differentiate between high and low anorectal malformations.

All the 3 patients reported to have meconium plug were infants. The age of presentation is comparable to what is indicated in most literature. [23,26] .The patients were relieved after a dilute barium enema was performed and did not show recurrence of symptoms on follow up in the clinic.

Most literature reports the diagnosis intussusception to be clinical and ultrasonographic [19], however Richard P Shurgena [17] in his retrospective study in a peadiatric hospital was unable to

develop a reliable clinical model that could accurately identify all patients with intussusception. In this study the only case of intussusception had not been suspected by the clinician. The intussusception was reduced by barium and patient's symptoms subsided with no recurrence on follow-up in peadiatric outpatient clinic (POPC). This single case is not statistically significant to conclude on the efficacy of contrast enema in the management of suspected children with intussusception. A prospective study may be required.

Contrast enema is not the primary investigation in children suspected to be having Parasitic infestation. In most literature[22] as well as this study the diagnosis is an incidental finding. The only case of parasitic infestation had presented to the clinician with symptoms of abdominal pain and diarrhea which made the clinician to suspected inflammatory bowel disease. The helminthes were detected at the external anal l region during examination. Though the colon size, contour and mucosal outline were reported as normal.

CONCULUSION

The study has shown that a significant number (58%) of children with suspected large bowel pathology do not necessarily have abnormal contrast enema findings.

The results of this study have demonstrated that contrast enema is still an important radiological investigation for diagnosis of large bowel pathology in children especially those with suspected congenital obstructive lesions.

This study has also demonstrated the epidemiological pattern of contrast enema finding as seen locally for children with suspected large bowel pathology where hirschsprung's disease is the commonest diagnosis.

Contrast enema examination had a very high sensitivity rate in the diagnosis of congenital obstructive lesions i.e Hirschsprungs (92%) and anal atresia (100%)

It has also shown that hirschsprung's disease is more common in boys than girls (3: 1) where as anal/colonic atresia has no sex predilection.

There is need for multidiagnostic approach towards the diagnosis of large bowel pathology in children, especially in cases that contrast enema don't seem to give a conclusive diagnosis or persistence of symptoms despite a normal enema report.

RECOMMENDATIONS

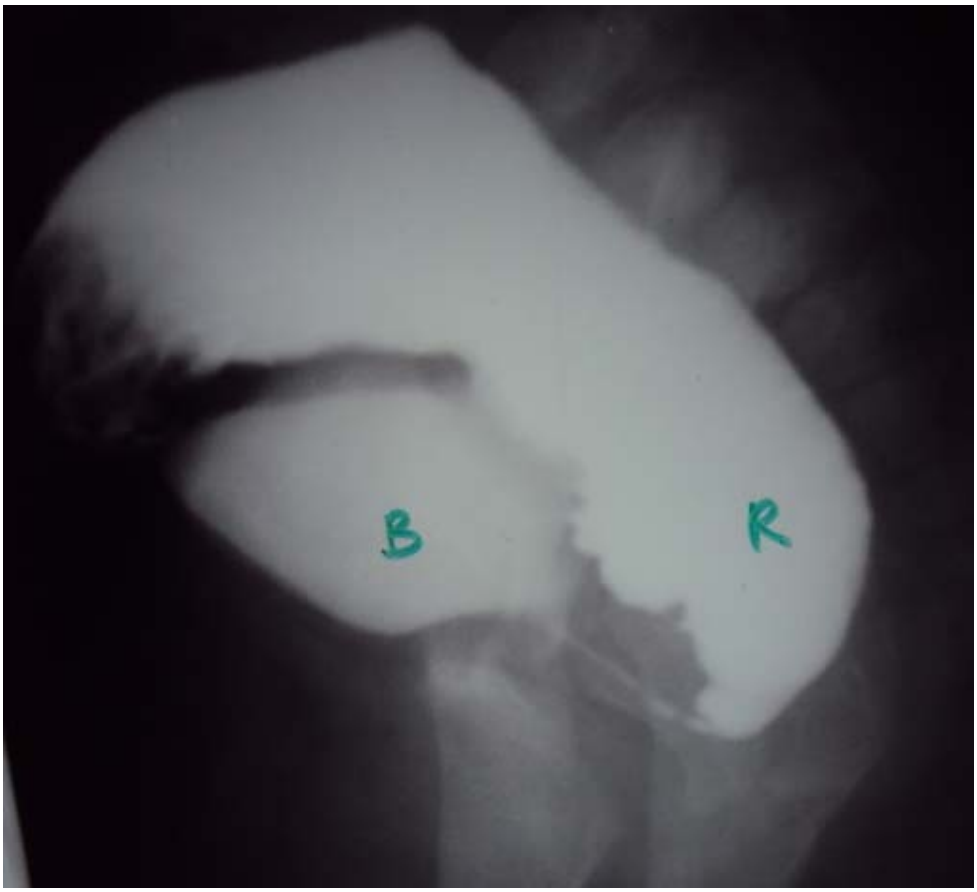
Contrast enema should be imaging modality of choice in evaluating children with suspected congenital obstructive lesions.

When contrast enema is inconclusive or shows normal findings in patients whose symptoms persist, other investigations should be considered e.g. biopsy or colonoscopy.

There is need for increased consultations between Clinicians and radiologist in order to make the best use of the enema examinations.

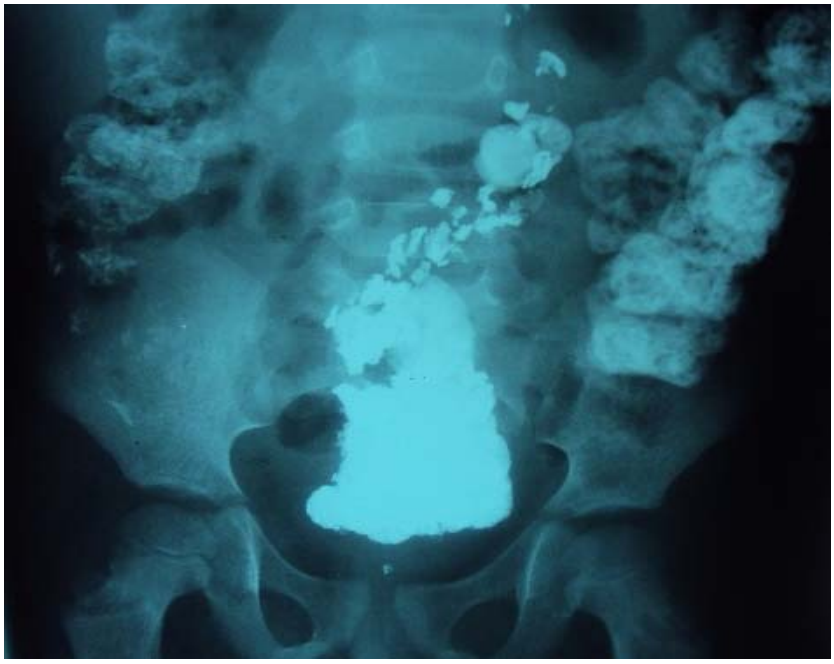
SELECTED IMAGES OF THE STUDY

FIGURE 11



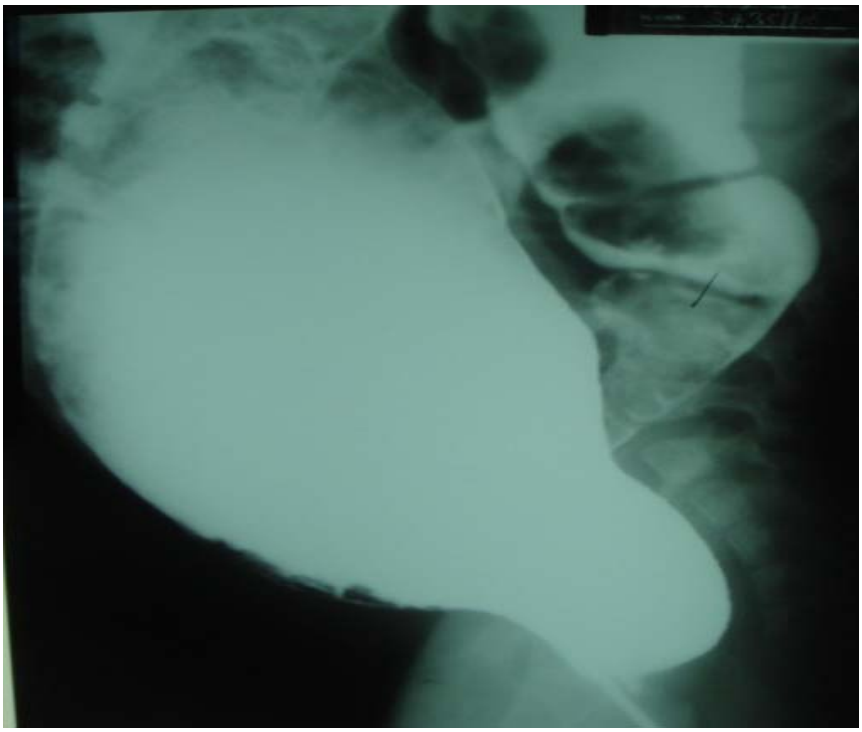
A colostogram of a 2 month old female showing a vesical fistula

FIGURE 12



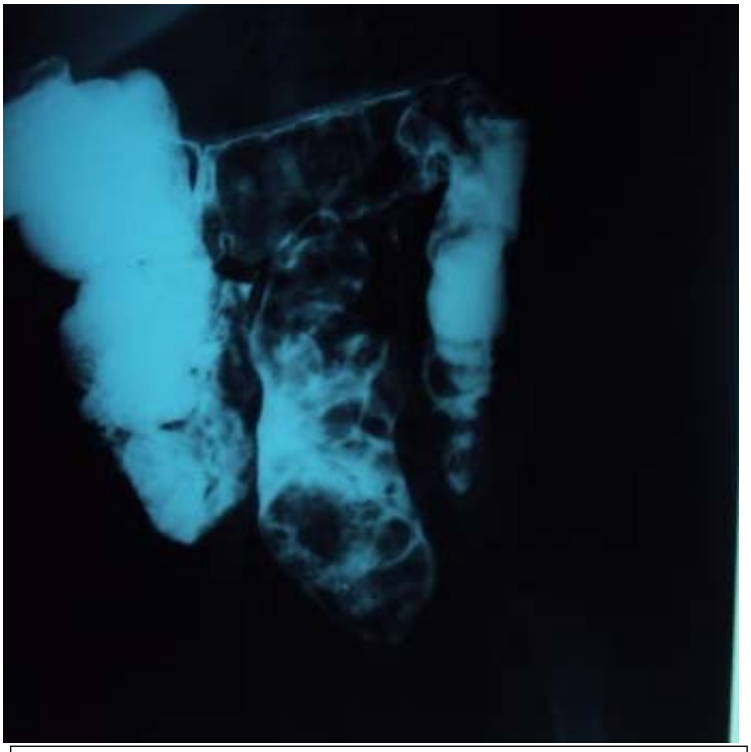
24 hr post evacuation in a patient with hirschsprung

FIGURE 13



Another case of Aganglionosis in a 18 month old

FIGURE 14



A case of fecal impaction in a 12 months old female

FGURE 15

Plain film of a 1 year old male shows multiple dilated loops of bowel consistent with low intestinal

REFERENCES.

1. K. Ramakrishran and D.C Scheid Opening pandoras box; The role of contrast enemas in Abdominal Imaging: *The Internet Journal Of Gastroenterology 2003 volume 2 number 1.*

2. Prof S. Chaula, Prof C. Faure, Dr Firdel : Rational use of diagnostic imaging in pediatrics: *report of WHO study group 1987 ISBN 92 4*

3. Thomas Curry ,James Dowdey and Robert Murry. *Christensen's Physics of Diagnostic Radiology 4th edition chapter 1 page 1,*

4. Roscoe Miller, Jovitus Skucas *: Radiolographic contrast agents. page 3-5 page 501 1977*

5. Margulis, Alexander R. : Barium enema examination of the colon: *Alimentary tract Roentgenology, 1989 Vol II , page 924.*

6. Cargil A, and Hately W :Preparation of colon prior to radiology . *British J of radiology , 51 : 910-912 1978.*

7. Stephen Chapman and Richard Nakielny. A guide to radiological procedures, Fourth Edition W.B. Saunders,2001: *Chapter 3-page 49, page 91, page 99-101.*

8. Ondeko John The role of barium enema examination in the diagnosis and evaluation of the pattern and radiological features of the large bowel at Kenyatta National Hospital. *MMed thesis 1985*

9. Mwanthi Kamau , Hirschprungs disease and other allied disorders as seen at KNH during a 5 year period of i973-1975 *MMed thesis 1978.*

10. Godrick Onyango, A review of management of Hirschprungs disease at KNH for aperiod of 10 years.1991 -1999. page 12-14,32 *MMed thesis 2002.*

11. E.J Irvine, J,O Conror, R, A Frost Prospective comparison of DCBE plus flexible sigmoidoscopy vs colonoscopy in rectal bleeding. *1997 Sept GUT 29 (9) 1188-1193*

12. Agwarral V.K, Mittal, A comparative study of double contrast barium enema and

colonoscopy for evaluation of rectal bleeding in children 1995 april –june ; *16(2) 132-7.*

13. R S Shah, H S Pikale ; Case report of an adenocacinoma in a 10 yr old. Journal of Postgraduate Medicine (JPGM). Year 1992, *vol 35, issue 2, page 81 -83.*

14. Richard P Shugerna; The diagnosis of intussusception, *J med genet 2001 380 729 – 739.*

15. Shant S, Steven L. Contrast enema for pediatric intussusception : is reflux into the terminal ileam necessary for complete reduction. *Issue 1 Pages 247-250 (January 2008)*

16. Keith L Moore, Persaud T V N,; The developing human Embryology : *Clinically oriented embryology pg 275. 5th Edition 2005.*

17. Stephanie Ryan, Michelle Mc Nicholas, Stephen Eustace. Anatomy for Diagnostic Imaging. *Second Edition. Saunders, 2004:165-168*

18. Andren L, Dux A, Feine U; Roentegen diagnosis of abdomen: *2nd Edition pg 275-300 1978.*

19. Ronald G Grainger and, David Allison, Andreas Adam, Adrian K. Dixon, Helen Carty, Alan Sprigg, Elian A. Zerhouni. A Textbook of Medical Imaging, *4th Edition. By Churchill Livingstone,2001:1199-1228*

20. Amberg J. R, Baensch W.E, Evans J.A, ; Alimentary tract roenterology: *pg 1063 –1097. 1962*

21. Karen F. Murray, Dennis L. Christie, Management of nausea and vomiting in children. American Academy of Pediatrics. *(Pediatrics in Review. 1998;19:337-341*

22. David Sutton, Text Book of Radilogy and Imaging. *7th edition 2002 volume II page (1773-4*

23. Bruce J, Huh Y, Cooney et al; Intussusception and evaluation of current management. *Journal of pediadrics 1987, 6, 663-667*

24. Hellar, Hernanz, Shulman et al. Application of new imaging modalities to the evaluation of common pediatric conditions. *EU Journal of pediatrics 1999, 135 : 632- 639*

25. Katz M, Kohn P; intussusception reduction , an international survey of pediatric radiologists *1992, 22, 318-322*

26. Losek JD .intussusception; Don't miss the diagnosis. *Pediatric emergency care 1993, 9 40-41*

27. Carolyne D .F, Friedman A.C : The radiology of Inflamatory bowel disease. *Med clin North Amer 1994, 78, 1353 – 1357.*

28. Loufer I, Hamilton J. The radiological differentiation between ulcerative colitis and granulomatous colitis .*Radiology 1976 , 66 259-261.*

29. Silverman F. N. Caffey's pediatric x-ray diagnosis. 8th edition. Year Book Medical Publishers,*1985:Page 1401-1520.*

30. John H. Juhl, Andrew B. Crummy, Janet E. Kuhlman, Essentials of Radiologic Imaging, *7th Edition, MedScut, 2001: 17-43.*

31. Gupta Arun Kumar, Guglani Bhuvnesh. Imaging of Congenital Anomalies of the Gastrointestinal Tract. *Indian J Pediatr 2005;72:403-14.*

32. Fisher S J, Fielder D G. A standard weight equation to assess the condition of North American lake herring. *J. Freshwater Ecol. 1998; 13:269-277.*

APPENDIX A : QUESTIONNAIRE

1. **SERIAL NUMBER**

2. **AGE** 2.1.1 Neonate(0-29d) 2.1.2 Infants (1m-2yr) 2.1.3 Child (2-12 yr)
3. **SEX** 3.1.1 Male 3.1.2 Female
4. **RACE** 4.1.1 African 4.1.2 Asian 4.1.3 Other
5. **CLINICAL DIAGNOSIS**

5.1.1 None 5.1.2? Hirshsprungs disease

5.1.3 Atresia- Ano-rectal, colonic 5.1.4 Inflammatory

5.1.5 Intussusceptions

5.1.6 **OTHERS** – colon pathology, polyps, rectal prolapse

6. **CLINICAL PRESENTATION**

6.1.1 Delayed meconium passage 6.1.2 Constipation

6.1.3 Abdominal pain 6.1.4 Diarrhea

6.1.5 Vomiting 6.1.6 Abdominal distension

6.1.7 Abdominal mass 6.1.8 Failure to thrive

6.1.9 Others

7. **TYPE OF CONTRAST**

7.1.1 Iodinated water soluble 7.1.2) Barium sulphate

8. **CONTRAST ENEMA DIAGNOSIS**

8.1.1 Hirshprungs disease/megacolon 8.1.2) Meconium plug

8.1.3 Intussusceptions 8.1.4) Fecal impaction

8.1.5 Colonic Atresia with fistula (urethral. 8.1.5.1 High (vesical) 8.1.5.2 fistula

8.1.6 Colonic atresia without fistula 8.1.6.1 high 8.1.6.2 low

8.1.7 Microcolon 8.1.8 Duplication cyst

8.1.9 Inflammatory 8.2.1 Tumour or mass lesion

8.2.2 Parasitic infestations 8.2.3 Normal

9. OTHER IMAGING STUDIES (IF AVAILABLE)

9.1.1 US

9.1.2 Abdominal X-ray

9.1.3 CT scan 9.1.4 MRI 9.1.5 NONE

10. SURGERY

10.1.1 **NO**

10.1.2 **YES** 10.1.2.1 Normal 10.1.2.2 Intussusception 10.1.2.3Micricolon

10.1.2.4 Megacolon 10.1.2.5 Mass/polyp 10.1.2.6Meconium ilius

10.1.2.7 Colonic Atresia

11. BIOPSY (IF AVAILABLE)

11.1.1 **NO**

11.1.2 **YES** 11.1.2.1 Normal 10.1.2.2 Aganglionosis 11.1.2.3 Granuloma

11.1.2.4 Amoeboma 11.1.2.5. Carcinoma

APPENDIX B: CONSENT FORM (ENGLISH)

Dr. Andambi David a Master of Medicine student at the Department of Diagnostic Radiology, University of Nairobi. Is doing a study on the role of Contrast enema in the diagnosis of large bowel pathology in children. Your child has been selected to participate. Please note that the information you give and the examination findings will be handled with utmost confidentiality.

The child's name will not be included in data collection form, but the X-ray number will be used.

Child's parent/guardian, I have been given the opportunity to ask questions concerning the study, and the questions have been answered to my satisfaction.

I understand that I am not obliged to participate, and that I may at any time during the course of the study revoke the consent for the study without any prejudice as the child's parent/guardian.

Signature…….. Witness……

Date…….

Child's file/x-ray no……

I certify that the child's parent/guardian has understood the nature of the study and has consented to fully participate.

Dr. Andambi David.

Signature……

Date……

APPENDIX B: CONSENT FORM (KISWAHILI)

Kibali cha kushiriki katika utafiti.

Daktari Andambi Davidl; ni mwanafunzi katika chuo cha udaktari, Chuo Kikuu cha Nairobi. Anafanya utafiti kuhusu thamani ya kutumia contrast enema kuwachunguza watoto walio na shida ya tumbo, na naomba uniruhusu kumshirikisha mtoto wako katika utafiti huu.

Habari utakayotoa au ile itakayopatikana katika uchunguzi, itakuwa siri na kutumika tu katika utafiti huu. Jina lake halitohusishwa, bali nambari yake ya uchunguzi ndiyo tu itakayo tumika.

Mzazi wa mtoto/mlezi: Nimepewa nafasi ya kukuuliza maswali ambayo yanahusu utafiti huu na mtoto wangu, masuali yamejibiwa kikamilifu.

Naelewa kwamba sio lazima nihusike katika utafiti huu, na pia naweza kubadili nia yangu kuhusu kuendelea kushiriki.

Asante sana kwa ushirikiano wako.

Tarehe .....

File ya mtoto/numbari ya x-ray.....

Nathibitisha kwamba mzee wa mtoto amefahamu na kukubali kushiriki katika utafiti huu.

Daktari Andambi David.

Sahihi..... .....

Tarehe.....

Appendix C: Budgetary justification

Budget

No.	Requirement	Cost(Kshs)
1	Stationary, photocopying, typing	18,000
2	Secretarial services	4,000
3	Data analysis	15,000

4	Printing and scanning documents	15,500
5	Binding	5,000
6	Data collection	40,000
7	Ethics fee	1,000
8	Contingency (10 % of budget).	9, 850
	TOTAL	108, 350

The above expenses will be met by the researcher.

The contingency allocation provided is to cater for any unforeseen expenditure.