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PAEDIATRIC SURGERY

Gastrointestinal obstruction in neonates and infants – a four-year profile in Chris Hani Baragwanath Academic Hospital

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Background: Different disease entities that cause gastrointestinal (GI) obstruction have been studied in isolation; however, no description of GI obstruction in neonates and infants in South Africa could be identified. This study aims to describe the profile of GI obstruction in neonates and infants at Chris Hani Baragwanath Academic Hospital (CHBAH) from January 2016 to December 2019.
Methodology: This was a retrospective record review conducted on all patients < 1 year of age with GI obstruction admitted to CHBAH. Data on age at presentation, sex, presenting symptoms, aetiology, diagnostic imaging, operative and non-operative management, complications, and 30-day mortality were collected.
Results: A total of 299 patients were enrolled in this study. They were predominantly male (*n* = 175, 58.53%) and were neonates at presentation (*n* = 177, 59.20%). Congenital malformations (*n* = 203, 67.89%) were more common than acquired conditions (*n* = 96, 32.11%). Anorectal malformation (ARM) and small bowel atresia were the most common congenital condition (*n* = 61, 20.40%; *n* = 34, 11.37% respectively). Intussusception was the most common acquired condition (*n* = 78, 26.08%). The morbidity rate was 95 (31.77%) with nosocomial sepsis and surgical site sepsis accounting for 49 (51.58%) of the morbidities. Mortality rate was 16 (5.35%) and 10 (62,5%) of the mortalities had associated nosocomial sepsis.
Conclusion: Congenital malformations of the GI tract are more common than acquired pathologies in neonates and infants in CHBAH. Sepsis causes significant morbidity in the postoperative period.
Keywords: gastrointestinal obstruction, infants, acquired, congenital

Introduction

Gastrointestinal (GI) obstruction occurs due to complete or partial luminal occlusion within the GI tract,[1] with a peak incidence during infancy and usually presents with abdominal distension, vomiting, constipation, and abdominal pain.[2,3] Due to the high frequency and non-specificity of these presenting symptoms, diagnosis can be delayed or missed altogether, leading to significant morbidity and mortality.[4] The reported mortality rate from intestinal obstruction is 3–11%.[5] The aetiological spectrum of GI obstruction in neonates and infants includes vascular, infective, autoimmune, metabolic or nutritional, inflammatory, neoplastic, and congenital causes.[5]

Globally, mortality under five years of age has declined over the past three decades from 93 deaths per 1 000 in 1990 to 38 deaths per 1 000 in 2021.[6] However, sub-Saharan Africa still has high rates of neonatal and infant mortality compared with the rest of the world.[7] In South Africa, the neonatal and infant mortality rates are estimated at 11 and 26 per 1 000 live births, respectively.[8] Studies documenting the aggregated mortality due to GI obstruction could not be identified in the published literature.

Different disease entities that cause GI obstruction have been studied in isolation;[9-11] however, the description of GI obstruction in neonates and infants in South Africa could not be identified. Therefore, this study aims to describe the profile of GI obstruction in neonates and infants at Chris Hani Baragwanath Academic Hospital (CHBAH) from January 2016 to December 2019.

Methodology

The study design consisted of a retrospective record review. Approval to conduct the study was obtained from the Human Research Ethics Committee (Medical) of the University of the Witwatersrand (M201182).

This study was conducted in the Department of Paediatric Surgery at CHBAH. CHBAH, located in Soweto, Johannesburg, is the largest hospital in South Africa, with a bed capacity of 2 680 beds. The outpatient paediatric surgery department sees 11 932 patients and 2 316 surgeries are performed annually.[12]

The study population consisted of all patients < 1 year of age admitted to the Department of Paediatric Surgery at CHBAH with a diagnosis of GI obstruction between January 2016 and December 2019. Patients with a functional

obstruction due to an underlying medical condition, including electrolyte abnormalities, sepsis, and patients presenting with postoperative complications referred for further management from other facilities, as well as those with incomplete records were excluded from the study.

Data were extracted from the Department of Paediatric Surgery database (Healthspace), captured on REDCap and exported to an Excel spreadsheet for analysis by one author (OB). The weekly departmental morbidity and mortality record was used as a supplementary data source. The following data were collected: age at presentation, sex, presenting symptoms, aetiology, diagnostic imaging, operative and non-operative management, complications, and 30-day mortality. The data capture instrument is shown in Supplementary file number 1.

Data analysis was performed using Stata v17 (*Stata Statistical Software: Release 17*. College Station, TX: StataCor LLC). Continuous data were expressed as mean and standard deviation. Categorical variables were expressed as frequencies and percentages.

Results

A total of 299 patients were included in this study, of which 175 (58.53%) were males and the majority, 177 (59.20%) were neonates. The sample realisation is shown in Figure 1. The mean (SD) age was 67 (93.8) days at presentation, and Table I displays the presenting symptoms.

Congenital malformations are more common, 203 (67.89%) than acquired causes, 96 (32.11%). The aetiology of GI obstruction is shown in Table II. VACTERL (the association between vertebral anomalies, anorectal malformations [ARM], cardiovascular anomalies, tracheoesophageal fistula, oesophageal atresia [OA], renal and, or radial anomalies and limb defects) association was noted in 10 (3.34%) of the patients.

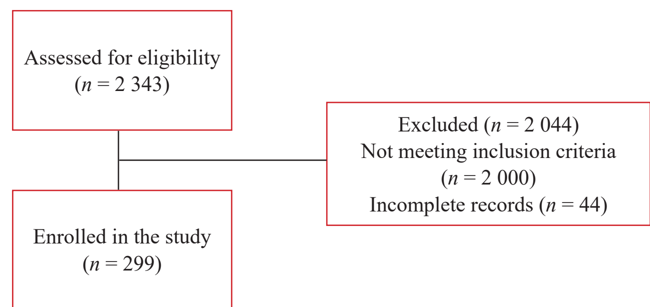

Figure 1: Study sample realisation

Table I: Presenting symptoms

Presenting symptom	*n* (%)
Vomiting, abdominal distension constipation	136 (45.48)
Vomiting and bloody mucoid stools	72 (24.08)
Failure to pass meconium	50 (16.72)
Respiratory distress	20 (6.69)
Abdominal distension and passing stools via fistula	19 (6.35)
Incarcerated inguinal hernia	2 (0.67)
Total	299 (100)

Radiological investigations were documented in 267 (89.30%) of the patients, of which 178 (59.53%) had a plain film X-ray, 69 (23.08%) patients had an ultrasound scan, a contrast study in 19 (6.35%) patients, and 1 (0.33%) patient had documented dual imaging.

The non-operative and operative management of patients is shown in Table III.

Postoperative complications were noted in 95 (31.77%) patients and are shown in Table IV.

The mortality was 16 (5.35%), as shown in Table V by diagnosis. Of the 16 patients who died, 10 (62.50%) had complications with nosocomial sepsis.

Table II: Aetiology of GI obstruction

Aetiology	Neonates *n* (%)	Infants *n* (%)	Total *n* (%)
Acquired			
Intussusception	0	78 (26.09)	78 (26.09)
Hypertrophic pyloric stenosis	1 (0.33)	15 (5.02)	16 (5.35)
Adhesive bowel obstruction	0	2 (0.69)	2 (0.69)
Total	1 (0.33)	95 (31.77)	96 (32.11)
Congenital			
Anorectal malformation (ARM)	52 (17.39)	9 (3.01)	61 (20.40)
Small bowel atresia	34 (11.37)	0	34 (11.37)
Duodenal atresia/stenosis	23 (7.69)	3 (1.00)	26 (8.69)
Malrotation with/without volvulus	16 (5.35)	2 (0.67)	18 (6.02))
Oesophageal atresia and/or tracheoesophageal fistula (OA/TOF)	17 (5.69)	0	17 (5.69)
Incarcerated inguinal hernia	3 (1.00)	9 (3.01)	12 (4.01)
Hirschsprung disease	4 (1.34)	4(1.34)	8 (2.68)
Meconium plug	7 (2.34)	0	7 (2.34)
ARM + OA/TOF	5 (1.67)	0	5 (1.67)
Other*	5 (1.34)	0	5 (1.34)
Meconium cyst with associated atresia	5 (1.67)	0	5 (1.67)
Duplication cysts	3 (1.00)	2 (0.67)	5(1.67)
Total	174 (58.19)	29 (9.69)	203 (67.89)

*colonic atresia, vascular ring, rectal web, midgut volvulus, oesophageal web

Table III: Non-operative and operative management of patients

Management	*n* (%)
Non-operative management	
Pneumatic reduction for intussusception	18 (6.02)
Rectal irrigations	7 (2.34)
Total	25 (8.36)
Operative management	
Exploratory laparotomy plus corrective procedure	152 (50.83)
Gastrointestinal diversion by stoma	69 (23.07)
Pyloromyotomy	16 (5.35)
Thoracotomy with/without TOF ligation or oesophageal anastomosis	16 (5.35)
Other	13 (4.68)
Inguinal hernia repair	8(2.68)
Total	274 (91.64)

*Other – dual operations (thoracotomy plus stoma, oesophagostomy plus gastrotomy), primary posterior sagittal anorectoplasty, trans anal pull through

Table IV: Postoperative complications

Complication	*n* (%)
Nosocomial sepsis	31 (32.63)
Wound sepsis	18 (18.95)
Multiple	15 (15.79)
Bowel anastomosis-related (breakdown or stricture)	9 (9.47)
Oesophageal stricture	8 (8.42)
Other*	7 (7.37)
Stoma complications	3 (3.16)
Recurrence of intussusception	2 (2.11)
Adhesive bowel obstruction	2 (2.11)
Total	95 (100)

*acute kidney injury, chylous ascites, leaking gastrostomy, gastroesophageal reflux, subglottic stenosis, ileus, pulmonary hypertension

Table V: Mortality by diagnosis

Diagnosis	*n* (%)
OA/TOF	5 (31.25)
Small bowel atresia	4 (25.00)
Malrotation	3 (18.75)
ARM + OA/TOF	1 (6.25)
Small bowel volvulus	1 (6.25)
Incarcerated inguinal hernia	1 (6.25)
Adhesive bowel obstruction	1 (6.25)
Total	16 (100)

Discussion

This study aimed to describe the profile of GI obstruction in patients < 1 year of age at a tertiary hospital regarding their presentation, aetiological spectrum, investigation and management, as well as postoperative morbidity and mortality.

The demographic profile of the patients was similar to that of other studies, showing a male predominance and the majority of patients presenting in the neonatal period.[2,3,13,14] Major congenital anomalies, such as GI tract anomalies, will be symptomatic in the neonatal period, hence most patients presented as neonates.

Vomiting, abdominal distention, and not passing stools were the most common presenting symptoms, which is similar to findings from other studies.[2,3,15] Most patients (89.30%) had a documented radiological investigation, with 59.53% having a plain film X-ray. Plain radiographs are usually the initial imaging modality used and can give information on the obstruction's presence, level and complications.[16] However, the aetiology of the obstruction may not be clear on a plain film X-ray; other imaging modalities may be used, or the aetiology may be identified intraoperatively.

Globally, 94% of congenital anomalies occur in low-to middle-income countries (LMICs) and this is due to higher fertility rates which translate to higher birth rates and net prevalence of anomalies.[17] Regional differences within the African continent have been noted regarding the prevalence of congenital and acquired GI anomalies in paediatric patients. A meta-analysis evaluating the prevalence and associated factors of birth defects among newborns in sub-Saharan African countries observed that the southern African region has the highest prevalence of birth defects at 43 per 1 000, with GI defects occurring at a rate of 1.50 per 1 000.[18] In this study, congenital anomalies accounted for 67.89% of the patients; this was higher than in Malawi (51%)[13] Nigeria (42.31%)[2] and Rwanda (33.33%).[5] Adane et al.[18] highlighted that, due to the higher economic status of South Africa, environmental teratogens are much more commonly available, leading to greater exposure and, therefore, a higher prevalence of congenital birth defects. In addition, many LMICs lack rigorous congenital anomaly surveillance programmes which makes the calculation of incidence and prevalence difficult.[17] Lack of folic acid supplementation, presence of chronic disease and intake of drugs during pregnancy are all associated with congenital birth defects.[18]

ARM was the most prevalent congenital anomaly (20.40%), similar in Malawi 18%[13] and Nigeria 22.31%.[2] According to Sharma et al.,[19] ARM is one of the most common congenital anomalies managed in LMICs and accounts for a considerable part of the paediatric operative workload in hospitals. The prevalence may be higher in LMICs because of potential nutritional deficiencies, environmental risk factors, teratogens and intrauterine infection.[18]

Hartford et al.,[9] in a 2022 systemic review and meta-analysis of ARM, noted that in LMICs the risk of wound dehiscence following single-stage repair was three-fold higher than in staged procedures. Previously, the Department of Paediatric Surgery at CHBAH had been performing single-stage repairs for selected patients, and due to postoperative wound dehiscence, the practice has changed to a 3-stage procedure. All but one of the patients in this study had a 3-stage ARM repair.

Intussusception was the most prevalent acquired aetiology, accounting for 26.09% of the cohort. Higher prevalence rates were documented in Nigeria (44.4%)[15] and Rwanda (34%).[5] In this study, 23.07% of the patients had a successful pneumatic reduction, with recurrence noted in two patients. Most of the patients with intussusception were managed operatively. This was due to a delay in presentation, leading to disease progression and development of complications, which led to the failure of conservative management as previously described in the CHBAH Department of Paediatric Surgery.[10,20,21] Disparities in the presentation, management and outcomes of intussusception between high-income and LMICs have been documented.[22] In Europe, 81% of patients

were treated conservatively with barium, air or saline enema with a recurrence rate of 1 in 10 patients, and surgery is performed in patients with contraindications to conservative management, including perforation, peritonitis, and shock.[23]

Operative management was performed in 91.46% of the cases, and all procedures were open. The operative rate was higher than in Kenya (55.3%)[3] and Malawi (52%).[13] A possible explanation is having better facilities and a higher specialist paediatric surgeon-to-patient ratio to perform the necessary and appropriate operative procedures.

Postoperative complications were reported in 31% of the patients, with surgical site sepsis accounting for 18.95% of the postoperative complications. This was higher than the rate reported by the GlobalSurg Collaboration in 2020[24] (12.8%) for middle income countries. Although South Africa is classified as an upper middle-income country, 62.7% of the population lives below the poverty line with one of the highest inequality rates between the rich and poor in the world.[25] In a South African study, Torborg et al.,[26] in 2019 also noted a lower postoperative surgical site infection rate of 4.7%. The difference between our study and the Torborg et al.[26] study is the operative procedures included in the studies were different. In our study, only clean contaminated abdominal and thoracic procedures were included which have a higher risk of surgical site infection. In contrast, Torborg et al.,[26] in addition to GIT procedures, included clean procedures, such as orthopaedic, ophthalmology, neurosurgery, cardiac and vascular.

Nosocomial sepsis accounted for 32.63% of the postoperative complications in this study. Nosocomial sepsis as a postoperative complication in paediatric surgery is not well documented. Only one study from Turkey in 2002 reported that nosocomial sepsis accounted for 2.74% of postoperative complications.[27] Withers et al.,[28] in a neonatal study conducted at CHBAH in 2021, reported that gram-negative nosocomial sepsis was a major contributor to morbidity and mortality in neonates. Although CHBAH has comparatively better facilities than other LMIC hospitals, lack of resources, personnel, cleaning supplies, and overcrowding were identified as factors contributing to hospital-acquired infections.

The mortality rate in this study was 5.35%, with the majority of deaths (31.25%) occurring in patients with OA/TOF. The majority of deaths in OA/TOF are caused by associated congenital anomalies, followed by sepsis and pulmonary insufficiency.[29] Livingston et al.[30] in 2015 also reported that the highest pooled mortality rates were seen with OA, midgut volvulus and jejunoileal atresia in LMICs in Africa. The cause of death was not highlighted in this study, but 10 (62.5%) of the patients who died had an associated postoperative morbidity of nosocomial sepsis. As already mentioned, nosocomial sepsis is a major contributor to mortality rates in neonates.

A limitation of the study was that it was done contextually at CHBAH, and the results may not be generalisable to other contexts. Due to the retrospective nature of this study, patient records had to be excluded due to incomplete data. The authors recommend that further studies exploring the causes of mortality in this age group be done in order to determine policies and actions that can be taken to reduce mortality rates.

Conclusion

Congenital malformations of the GI tract are more common than acquired pathologies in neonates and infants at CHBAH, with intussusception as the most common acquired cause of GI obstruction in infants. Sepsis causes significant morbidity in the postoperative period, and mortality is more common in patients with OA/TOF.

Conflict of interest

The authors declare no conflict of interest.

Funding source

No funding was required.

Ethical approval

Approval to conduct the study was obtained from the Human Research Ethics Committee (Medical) of the University of the Witwatersrand (M201182).

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Supplement:

DATA EXTRACTION SHEET

Research number					**Date**			
sex					**DOB**		**Age**	
Pulse		RR		weight		RR		T◦C

PRESENTING COMPLAINT	TICK	RADIOLOGICAL INESTIGATION		AETIOLOGY	
a. Vomiting		Abdominal Xray		1. Infantile hypertrophic pyloric stenosis	
b. Abdominal distention		Ultrasound		2. Intestinal atresia: a. duodenal b. jejunal c. ileal	
c. Constipation		CT scan		3. Midgut volvulus	
d. Diarrhea		MRI		4. Intussusception	
e. Mucoid bloody stool				5. Intestinal Malrotation	
f. Abdominal mass				6. Inguniscrotal hernia	
g. Fever				7. Anorectal malformation	
h. Other: specify				8. Hirschsprung's disease	
				9. Acute appendicitis	
				10. Other: specify	

INTRAOPERATIVE FINDINGS			OPERATION PERFORMED	
1.				
2.				
3.				
4.				
5.				
6.				
7.				

POSTOPERATIVE COMPLICATIONS		
1.		
2.		
3.		
4.		
5.		

Mortality	
Yes	

No