

Prevalence, interventions and outcomes of gastrointestinal surgical conditions in neonates

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Abstract

Background: Gastrointestinal surgical conditions in neonates are a significant concern in pediatric surgery, associated with high morbidity and mortality rates. Early identification and management of these conditions are crucial for improving outcomes.

Objective: This study aims to investigate the prevalence, surgical interventions, clinical outcomes, and associated factors of gastrointestinal surgical conditions in neonates, providing insights to enhance neonatal care.

Methods: Medical records for 59 neonates admitted with gastrointestinal surgical conditions in Khartoum Teaching Hospital and Ibrahim Malik Teaching Hospital between January 2020 and August 2022 were retrospectively reviewed. Data collected included socio-demographic information, maternal and birth histories, clinical presentations, surgical interventions, and short-term outcomes. Statistical analyses were performed to identify correlations between various factors and clinical outcomes.

Results: 59 cases of neonates with gastrointestinal surgical conditions were included. The male-to-female ratio of 1.2:1 and a term-to-preterm ratio of 7.4:1. The most common conditions included anorectal malformations 16 (27.1%), Hirschsprung disease 13 (22%), jejunal atresia 11 (18.6%), and malrotation 9 (15.3%). Surgical interventions were critical, with colostomy in 19 (32.2%), anoplasty in 14 (23.7%), and laparotomy in 9 (15.2%) being the most frequently performed procedures. The study reported a mortality rate of 23.7%, primarily due to complications such as respiratory failure and sepsis, particularly in cases of jejunal atresia and anorectal malformations. Statistical analysis revealed significant correlations between lower birth weight, absence of antenatal diagnosis, and poorer outcomes.

Conclusion: This study highlights the substantial challenges posed by gastrointestinal surgical conditions in neonates, emphasizing the need for prompt surgical intervention and comprehensive care strategies. Understanding the specific conditions, associated risks, and outcomes is vital for optimizing management and improving prognosis. Future efforts should focus on enhancing antenatal screening protocols and fostering early diagnosis and treatment, which may improve outcomes for this vulnerable population.

Keywords: Prevalence; Interventions; Outcomes; Gastrointestinal Surgical Conditions; Neonates

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1. Introduction

Congenital and acquired gastrointestinal tract diseases are generally rare, with prevalence rates varying between 1 in 300 and less than 1 in 10,000 [1]. Congenital malformations pose a substantial challenge to pediatric surgical care in tertiary centers, with gastrointestinal tract (GIT) malformations ranking as the third most common type. In high-income countries (HICs), these conditions are often identified prenatally or during the neonatal period, enabling early intervention in specialized centers and significantly improving survival rates over recent decades. Conversely, in low- and middle-income countries (LMICs), prenatal detection of GIT malformations is uncommon, postnatal diagnosis is frequently delayed, and mortality rates remain considerably higher compared to HICs [2,3].

Neonatal surgery has advanced significantly due to collaboration among pediatric surgeons, neonatologists, anesthesiologists, pathologists, radiologists, biochemists, and nurses. Outcomes for neonatal surgical conditions have steadily improved, with mortality rates for congenital intestinal obstructions at Great Ormond Street Hospital dropping from 50% in the 1950s–60s to under 5% today. This progress is attributed to a better understanding of neonatal physiology, and advances in fluid management, nutrition, mechanical ventilation, and surgical techniques. However, challenges remain, particularly in improving survival rates for severe conditions like necrotizing enterocolitis (NEC) [4].

Congenital anomalies of the gastrointestinal tract are the leading cause of intestinal obstruction in newborns and represent the most common surgical emergency during the neonatal period. Typical clinical signs include failure to pass meconium, abdominal distension, feed regurgitation, vomiting, and visible bowel loops. However, these symptoms can vary depending on the underlying cause, the level of obstruction, and its duration. Delayed diagnosis can worsen abdominal distension, leading to diaphragmatic splinting and respiratory distress. Complications such as aspiration pneumonia, severe dehydration, peripheral circulatory failure, and metabolic acidosis may arise. In cases of prolonged obstruction, intestinal gangrene, and perforation can occur, resulting in peritonitis and septicemia [5].

Surgical interventions play a vital role in managing congenital anomalies, especially in low- and middle-income countries (LMICs), where these conditions significantly impact child morbidity and mortality. However, access to quality pediatric surgical care in LMICs remains limited due to sociocultural, economic, and structural barriers, resulting in a considerable unmet need. Research indicates that pediatric surgery is a cost-effective solution that can help prevent premature mortality and long-term disabilities [6]. This study aims to elucidate the spectrum of gastrointestinal surgical conditions in neonates, highlighting their prevalence, associated factors, surgical interventions, and short-term outcomes to inform clinical practice and enhance neonatal care.

2. Methodology

This study utilized a retrospective cohort design to assess gastrointestinal surgical conditions in neonates. Medical records of neonates admitted with these conditions from January 2020 to August 2022 were reviewed. A total of 59 neonates with gastrointestinal surgical conditions were included in the study. All neonates diagnosed with gastrointestinal conditions requiring surgical treatment during the specified period were included, and those with incomplete medical records were excluded.

2.1. Data Collection

Data were extracted from medical records and included the following variables:

- Socio-demographic Information: Age, sex, gestational age and maturity, birth weight, and mode of delivery.
- Types of gastrointestinal surgical conditions.
- Surgical Interventions: Types of surgical procedures performed and any associated complications.
- Short-term Outcomes: mortality rates, complications post-surgery, and length of hospital stay.

2.2. Statistical Analysis

Statistical analyses were conducted using appropriate software, SPSS version 24. Descriptive statistics were used to summarize the data. Chi-square tests were applied to evaluate correlations between categorical variables, while the chi-square test was used for continuous variables. A p-value of <0.05 was considered statistically significant. Multivariate analyses were performed to identify independent predictors of surgical outcomes, focusing on factors such as birth weight, antenatal diagnosis, and specific gastrointestinal conditions.

2.3. Ethical Considerations

The study received approval from the ethics committees of the Sudan Medical Specialization Board, the EDC, and the Ministry of Health-Sudan, with permission from Ibrahim Malik and Khartoum Teaching Hospitals. Participant confidentiality was maintained using serial numbers.

3. Results

The study reveals significant insights into gastrointestinal surgical conditions among neonates, highlighting their prevalence, outcomes, and related factors. 59 neonates with gastrointestinal surgical conditions were included with a male-to-female ratio of 1.2:1 and a term-to-preterm ratio of 7.4:1 [Table 1]. Regarding birth weight, 49 neonates (83%) had an average weight, while 10 (17%) were classified as low birth weight. In terms of gestational age, 52 (88.1%) were full-term, and 7 (11.9%) were preterm. Of the neonates, 41 (69.5%) were delivered vaginally and 18 (30.5%) by cesarean section [Table 2].

Anorectal malformations were the most common gastrointestinal conditions, accounting for 16 cases (27.1%). This was followed by Hirschsprung disease in 13 cases (22%), jejunal atresia in 11 cases (18.6%), malrotation in 9 cases (15.3%), esophageal atresia in 5 cases (8.5%), duodenal atresia in 2 cases (3.4%), pyloric stenosis in 2 cases (3.4%), and necrotizing enterocolitis (NEC) in 1 case (1.7%) [Table 3].

The surgical procedures performed were essential for the management of these conditions. The performed operations included: colostomy 19 (32.2%), anoplasty 14 (23.7%), laparotomy 9 (15.2%), intestinal anastomosis 5 (8.4%), esophageal anastomosis 5 (8.4%), and Ladd's operation 5 (8.4%) [Table 4].

The study found a concerning mortality rate of 23.7%, with most deaths attributed to complications such as respiratory failure and sepsis. Jejunal atresia and anorectal malformations were associated with the highest mortality rates, highlighting the severity of these conditions [Table 5].

Statistical analysis indicated significant associations between certain factors and outcomes. Notably, lower birth weight and a lack of antenatal diagnosis were correlated with poorer outcomes.

Table 1 Demographic Characteristics of Neonates

Characteristic	Count	Percentage (%)
Total Neonates	59	100
Male	32	54.23
Female	27	45.76
Male-to-Female Ratio	-	1.2:1
Full-Term	52	88.1
Preterm	7	11.9

Table 2 Birth Weight and Delivery Method

Characteristic	Count	Percentage (%)
Average Birth Weight	49	83.0
Low Birth Weight	10	17.0
Vaginal Delivery	41	69.5
Cesarean Section	18	30.5

Table 3 Prevalence of Gastrointestinal Surgical Conditions

Condition	Number of Cases	Percentage (%)
Anorectal Malformations	16	27.1
Hirschsprung Disease	13	22.0
Jejunal Atresia	11	18.6
Malrotation	9	15.3
Esophageal Atresia	5	8.5
Pyloric Stenosis	2	3.4
Duodenal Atresia	2	3.4
NEC	1	1.7
Total	59	100%

Table 4 Surgical Interventions Performed

Surgical Procedure	Number of Cases
Colostomy	19
Anoplasty	14
Rectal Biopsy	11
Laparotomy	9
Intestinal Anastomosis	5
Oesophageal Anastomosis	5
Ladd's Operation	5
Others	8
Total	76

Table 5 Association between gastrointestinal conditions and outcome

Diagnosis	Total	Discharge No. (%)	Died No. (%)
Duodenal atresia	2	1 (2.2%)	1 (7.1%)
Jejunal atresia	11	6 (13.3%)	5 (35.7%)
NEC	1	1 (2.2%)	0 (0)
Esophageal atresia	5	3 (6.7%)	2 (14.3%)
Pyloric stenosis	2	2 (4.4%)	0 (0)
Malrotation	9	7 (15.5%)	2 (14.3%)
Hirschsprung disease	13	13 (28.9%)	0 (0)
Anorectal malformation	16	12 (26.7%)	4 (28.6%)
Total	59	45 (100)	14 (100%)

4. Discussion

The present study highlights the epidemiology, surgical management, and outcomes of neonatal gastrointestinal surgical conditions in two tertiary hospitals in Khartoum, Sudan. The findings emphasize the urgent need for improved neonatal surgical care and prenatal diagnostic practices, particularly in low-resource settings.

In our study, males represented 54.23% (32) of the cases, yielding a male-to-female ratio of 1.2:1 and a term-to-preterm ratio of 7.4:1. This differs from findings by Asindi et al. in a Saudi Arabian study, where males comprised 63% of the cases [7]. In contrast, a study by Abrahams et al. in South Africa found that males represented 48% of their cohort, with preterm cases comprising 52% [8]. Although preterm neonates are generally at higher risk for gastrointestinal anomalies due to immature organ development, the lower prevalence observed in our cohort may suggest underdiagnosis or reduced survival rates of preterm infants in resource-limited settings.

In our study, anorectal malformations (27.1%) and Hirschsprung disease (22%) were the most common, with a notably high prevalence of jejunal atresia (18.6%) and malrotation (15.3%). Asindi from Saudi Arabia identified anorectal malformations, tracheoesophageal fistula with atresia, intestinal atresia, and Hirschsprung's disease as the major lesions. In contrast, Sharma et al. reported a substantial increase in the incidence of anorectal malformations, which doubled from 2004 to 2014-15. During the same period, admissions for tracheoesophageal fistula (TOF) tripled, followed by an increase in cases of gastroschisis and omphalocele. Hirschsprung disease, intestinal obstructions, and atresia were significant contributors [7,9].

Surgical interventions were essential in all cases. Colostomy (32.2%) was the most common procedure, reflecting its pivotal role in managing anorectal malformations and other obstructive conditions. Anoplasty (23.7%) and laparotomy (15.2%) were also frequently performed. Despite the surgical successes, the complexity of neonatal surgical care highlights the need for specialized training and infrastructure to improve procedural outcomes.

The mortality rate of 23.7% is concerning but not entirely unexpected in similar contexts. It underscores the complex interplay of factors such as the severity of congenital anomalies, delayed presentation, limited antenatal diagnostic capabilities, and challenges in postoperative care. Abdul Aziz et al. reported that congenital gastrointestinal (GIT) conditions account for up to 40% of emergency neonatal surgeries, with mortality rates often surpassing 50% in many low- and middle-income countries (LMICs). The disparity in outcomes worldwide is striking; for example, the mortality rate for gastroschisis ranges from 75% to 100% in many LMICs, compared to less than 4% in high-income countries (HICs). Contributing to these poor outcomes are factors such as the lack of antenatal diagnosis, delayed presentation, limited neonatal transport and hospital resources, insufficient trained personnel, and inadequate access to intensive care and parenteral nutrition for neonates. In Uganda, it is estimated that only 3.5% of the demand for neonatal surgery is met by the healthcare system [3].

Surgical outcomes for gastrointestinal congenital anomalies between high-income countries (HICs) and low- and middle-income countries (LMICs). While HICs achieve far better results, neonatal surgical mortality rates in LMICs are alarmingly high, surpassing those for older children and adults (1%–4%). These inequities emphasize neonatal surgical care as a global health priority. The findings also reflect the broader neglect of pediatric and neonatal surgery, in global health efforts, with minimal focus on LMICs. Addressing these gaps requires urgent investment and attention to improve worldwide access and outcomes for neonatal surgical care [10]. In South Africa, a study examining both congenital and acquired abdominal surgical cases found a 30-day postoperative mortality rate of 11% [8].

The study found that most deaths were attributed to complications such as respiratory failure and sepsis. Jejunal atresia and anorectal malformations were associated with the highest mortality rates, highlighting the severity of these conditions.

Statistical analysis revealed critical associations between poor outcomes and factors such as low birth weight and the absence of antenatal diagnosis. Low birth weight is a well-documented risk factor for neonatal morbidity and mortality, primarily due to reduced physiological reserves and increased susceptibility to infections.

Prenatal ultrasound is crucial in detecting fetal gastrointestinal anomalies, allowing for early diagnosis and optimal perinatal care. Timely detection facilitates delivery planning at tertiary centers with specialized neonatal surgical expertise, significantly improving outcomes for high-risk neonates. Additionally, routine ultrasound screening helps identify associated anomalies, which can greatly impact prognosis and management strategies [11].

Furthermore, strengthening neonatal surgical care through training programs, better resource allocation, and post-operative support systems is paramount. Emphasis should also be placed on improving neonatal intensive care units (NICUs) to manage complications such as sepsis and respiratory failure effectively.

To improve outcomes for neonates with gastrointestinal anomalies, it is essential to strengthen antenatal screening by standardizing ultrasound protocols for early detection and ensuring healthcare providers are adequately trained to make timely referrals. Perioperative care protocols should be enhanced to reduce mortality rates associated with respiratory failure and sepsis in the NICU. Additionally, conducting longitudinal studies to evaluate the long-term outcomes of surgical interventions will provide valuable insights into survival rates and quality of life. Finally, efforts must be made to facilitate equitable access to specialized surgical care, particularly in underserved regions, to ensure timely and effective treatment for all affected infants.

4.1. Study Limitations and Future Research:

This retrospective, two-hospital study limits data completeness and generalizability, potentially underrepresenting neonatal surgical conditions regionally. Prospective multicenter studies are essential for a broader understanding of their epidemiology and outcomes.

5. Conclusion

This study highlights the substantial challenges posed by gastrointestinal surgical conditions in neonates, emphasizing the need for prompt surgical intervention and comprehensive care strategies. Understanding the specific conditions, associated risks, and outcomes is vital for optimizing management and improving prognosis. Future efforts should focus on enhancing antenatal screening protocols and fostering early diagnosis and treatment, which may improve outcomes for this vulnerable population.

Compliance with ethical standards

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Disclosure of conflict of interest

The authors declare that they have no conflicts of interest.

Statement of informed consent

Informed consent was obtained from all individual participants included in the study.

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