SVOA Paediatrics

ISSN: 2755-1660

ScienceVolks Open Access

Research Article

Management and Outcome of Intestinal Malrotation in Paediatric Age Group in Paediatric Surgery Centers in Sudan from March 2019 to March 2020

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https://doi.org/10.58624/SVOAPD.2025.04.009

Received: April 21, 2025

Published: May 08, 2025

Citation: Alhassan F, Aljaleel IAA, Elkheir IS. Management and Outcome of Intestinal Malrotation in Paediatric Age Group in Paediatric Surgery Centers in Sudan from March 2019 to March 2020. *SVOA Paediatrics 2025,* 4:3, 55-60. doi: 10.58624SVOAPD.2025.04.009

Abstract

Background: Intestinal malrotation is a congenital abnormality of intestinal rotation and fixation that is of great interest to paediatric surgeons because it can produce volvulus of the midgut, which can have disastrous effects if diagnosed too late. This study assessed the outcomes of intestinal malrotation in paediatric surgery centers in Sudan.

Methods: Medical records of all paediatric patients with symptomatic malrotation who underwent open Ladd's surgery between March 2019 and March 2020 were evaluated in this retrospective cross-sectional study. The following patient variables were assessed: age, length of symptoms, clinical presentation, imaging, related anomalies, complications, and mortality. Chi-square analysis, association, and regression tests were performed to compare the groups, with a significance level of $p < 0.05$.

Results: The Open Ladd's operation was performed in 57 patients (41 males and 16 females). Bilious vomiting accounted for 70.2% of the presenting symptoms, whereas most patients (54.4%) were neonates. Seven patients had midgut volvulus. All the patients underwent abdominal radiography. In addition, seven patients underwent an upper gastrointestinal (UGI) contrast study. Four patients developed postoperative complications, and two patients died postoperatively, yielding an overall mortality rate of 3.5%.

Conclusions: Until proven otherwise, neonates exhibiting bilious vomiting should be suspected of having malrotation and should receive immediate medical attention. This study found that even with delayed presentation and inadequate facilities, intestinal malrotation had a good prognosis in Sudan.

Keywords: *Children, Bilious vomiting, Intestinal malrotation, Volvulus, Ladd's procedure, Sudan*

Introduction

Malrotation is a congenital abnormality in which the intestines do not rotate and fixate correctly because of disruption of normal embryologic development of the bowel [1]. During the sixth week of normal embryologic development, the midgut grows rapidly, and the bowel herniates. During weeks 10 and 11, the gut begins a 270° anticlockwise rotation around the axis of the superior mesenteric artery and returns to the abdomen. By the 12th week, fixation occurs. According to previous reports, symptomatic malrotation occurs in one of every 6000 live births [2].

The occurrence of this condition in African populations remains unclear. Malrotation can also be associated with other anomalies, including duodenal webs/atresia, Meckel's diverticulum, omphalocele, and intussusception [3,4]. Anorectal abnormalities and Hirschsprung's disease are infrequently associated with malrotation [5]. Midgut volvulus, the rotation of the gut along its mesenteric stalk, is an acute presentation of intestinal malrotation. More than half of the patients developed symptoms within the first month of life, and almost all experienced bile-stained vomiting [6]. The age and presentation determine the clinical characteristics of the malrotation. Children's symptoms include frequent vomiting (both bilious and non-bilious), intermittent unexplained abdominal pain, diarrhea, and early satiety [7]. Although it is uncommon, adults can present with features of intestinal malrotation, which can cause subacute abdominal discomfort in addition to chronic stomach pain [8]. An upper gastrointestinal series is the gold standard diagnostic tool for identifying intestinal malrotation. Alternative possibilities include abdominal ultrasonography, color Doppler ultrasonography, and plain abdominal radiography [9]. The patient's presentation and presence or absence of a midgut volvulus determine the need for preoperative examination and management of malrotation [10].

Rationale

Given the potentially disastrous effects of malrotation linked to midgut volvulus, early recognition and appropriate management are critical. Malrotation warrants special attention due to its variable presentation across a wide age range and the urgency of intervention when midgut volvulus or intestinal gangrene is present. In low-resource settings like Sudan, factors such as delayed presentation and limited diagnostic tools further influence patient outcomes, making the condition a significant paediatric surgical challenge.

Objectives

To review and evaluate the clinical presentations, diagnostic approaches, surgical management, and outcomes of intestinal malrotation in children treated at Sudan's paediatric surgery centers between March 2019 and March 2020.

Material and Methods

This retrospective descriptive study was conducted at paediatric surgery centers across Sudan between March 2019 and March 2020. The study sites included Omdurman Teaching Hospital, Khartoum Teaching Hospital, Soba University Hospital, Khartoum North University Hospital, Elribat University Hospital, and the National Centre of Paediatric Surgery. Data collection focused on patient demographics, clinical presentation, imaging studies, surgical procedures performed, complications, and the resolution of preoperative symptoms.

Inclusion Criteria: The study included paediatric patients aged one day to 16 years diagnosed with intestinal malrotation and who underwent Ladd's procedure at the participating paediatric surgery centers during the specified study period. The diagnosis was confirmed intraoperatively in all cases.

Data Analysis and Management: Data analysis was performed using the Statistical Package for the Social Sciences (SPSS) version 24.0 (IBM Corp., Armonk, NY, USA) [11]. Results were presented in tabular format, and Chi-square tests were conducted to assess associations between variables. A significance level of $p < 0.05$ was applied.

Ethical Considerations: Ethical approval for the study was obtained from the Sudan Medical Specialization Board (SMSB) Ethical Committee before the initiation of the research.

Results

This study involved 57 patients. Forty-one patients (71.9%) were male, and 16 (28.1%) were female, with a male-to-female ratio of 2.5:1. The percentage of neonates was 54.4%. Ninety-three percent of neonates were full-term. Half of the patients had emergency laparotomy and Ladd's procedure on the day of admission, and the rest had the surgery on the next day or two [Table-1]. The clinical symptoms were varied, and several symptoms could occur in the same patient. The most prevalent presenting symptom was bilious vomiting, which occurred in 40 (70.2%) [Table-2]. Associated anomalies were observed at 18 (31.6%). None of the patients was diagnosed antenatally. All the patients underwent abdominal radiography. Seven patients (12.3%) underwent an upper gastrointestinal contrast scan, while two (3.5%) underwent abdominal ultrasonography. One patient (1.8%) had a CT abdomen. All the patients underwent open Ladd's procedure surgery.

Table 1. Patient age, sex, and timing of surgery.

value	N	%
Age		
Neonate	31	54.4%
Infant	11	19.3%
Toddler	7	12.3%
Children and adolescents	8	14%
Gender		
Male	41	71.9%
Female	16	28.1%
Timing of operation		
Same day operation	29	50.9%
Day 1 after Presenting to the ED.	9	15.8%
>1 day after Presenting to the ED	19	33.3%

Table 2. Clinical symptoms of patients with intestinal malrotation.

Symptoms	N	%
Bilious vomiting	40	70.2 %
Non bilious vomiting	12	21.1 %
Abdominal distension	24	42.1 %
Recurrent abdominal pain	16	28.1 %
Failure to thrive	8	14%
Failure to pass meconium	8	14 %
Constipation	8	14%
Bloody stool	2	3.5 %
Red currant jelly stool	1	1.8 %

Midgut volvulus was observed in seven patients (12.3%), all diagnosed intraoperatively [Figure-1]. In terms of complications, two patients (3.5%) had a burst abdomen, one patient (1.8%) had wound dehiscence, and one patient (1.8%) developed postoperative intussusception; all of them needed surgery for the complications. The mortality rate in our study was 3.5%. Two neonates were diagnosed with malrotation and volvulus intraoperatively, and both had intestinal gangrene during surgery.

To evaluate the outcomes of intestinal malrotation in Sudan, all independent variables were cross-tabulated, and a chi-square test was conducted to assess relationships between variables. No significant associations were found between preterm birth, acute symptoms, operating time, associated malformations, volvulus, and the outcomes (postoperative complications and mortality) ($p > 0.05$). Interestingly, there was no statistically significant difference between neonates and other age groups regarding complications and mortality ($p = 1.0$).

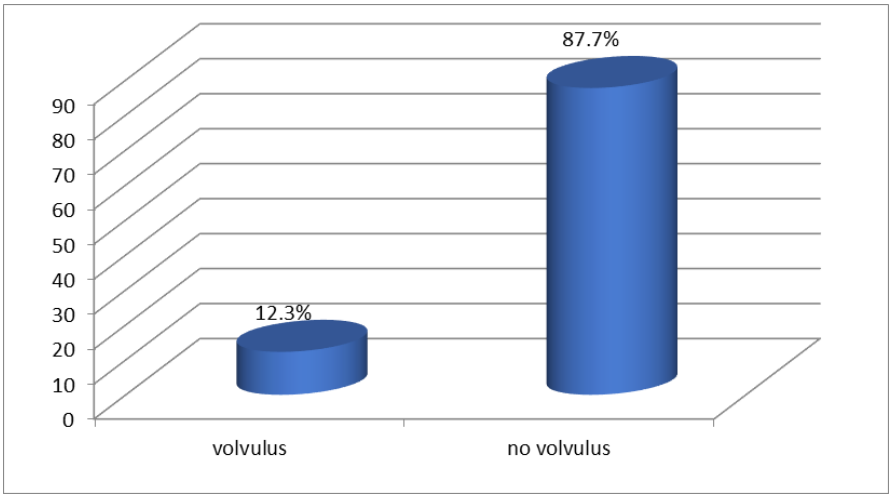

Figure 1. *Distribution of volvulus among paediatric patients with intestinal malrotation.*

Discussion

Intestinal malrotation is not uncommon and should always be considered in the differential diagnosis for children, especially neonates, presenting with bilious vomiting or signs of bowel obstruction. Clinical presentation can vary widely, but bilious vomiting remains the hallmark sign due to midgut involvement and potential volvulus formation [1,2,13].

In our study, there was a male predominance of 71.9%, consistent with several studies reporting a slightly higher prevalence in males. Anand et al. observed that 74.6% of their malrotation cases were male, while Raitio et al. also reported a male-to-female ratio of approximately 2:1 [8,12].

Most of our patients (54.4%) were neonates, aligning with findings from Svetanoff et al., who highlighted a peak incidence during the neonatal period, and Jabbar et al., who found that 50% of cases occurred within the first month of life [13,14].

In terms of clinical presentation, 78.9% of our patients had acute symptoms, compared to 56% of patients with recurrent symptoms in Dekonenko et al.'s cohort, which included only patients older than one year [18]. This contrast likely reflects age distribution differences and supports the view that neonatal cases tend to be more acute. Bilious vomiting was the most common symptom in our cohort (70.2%), comparable to the 67.6% reported by Jabbar et al. and 65% in Svetanoff et al.'s multicenter review [13,14].

Diagnostic imaging remains a challenge in low-resource settings. An upper gastrointestinal (UGI) contrast study - the gold standard - was performed in only 12.3% of our patients [7,13]. In contrast, Dekonenko et al. reported UGI use in 74% of their cases [18]. Similarly, Yang et al. found that 80% of patients with suspected volvulus underwent UGI, leading to more timely diagnosis [15]. In our study, the diagnosis's reliance on clinical judgment reflects systemic limitations, as ultrasound and CT were also used sparingly (3.5% and 1.8%, respectively). These gaps emphasize the urgent need for improved radiologic infrastructure in our emergency settings.

Midgut volvulus was identified in seven patients (12.3%), all diagnosed intraoperatively due to the unavailability of preoperative imaging such as upper gastrointestinal (UGI) contrast studies. These patients commonly presented with bilious vomiting, abdominal distension, lethargy, irritability, signs of dehydration, and delayed capillary refill. Volvulus is the most feared complication of malrotation, occurring in 60–70% of neonatal cases, with up to 15% resulting in intestinal strangulation [9,15]. Delayed diagnosis can lead to ischemia, necrosis, septicemia, and short bowel syndrome [15]. The incidence in our study was lower than the 44.4% reported by Bostancı et al. and the 38.1% in a multicenter study by Yang et al., where 18.5% required bowel resection due to necrosis [15,16]. This discrepancy may reflect underdiagnosis or missed cases in general surgical centers lacking paediatric expertise. The reliance on clinical judgment in the absence of diagnostic tools highlights the challenges faced in resource-limited settings. Strengthening diagnostic capabilities and ensuring early referral to paediatric surgical services are critical for improving outcomes, particularly in neonates who are more vulnerable to rapid deterioration.

The postoperative complication rate in our series was 7%, slightly higher than the 5.3% reported by Kidd et al. [10]. Observed complications included wound infection, wound dehiscence, burst abdomen, postoperative ileus, and incisional hernia. While El-Gohary et al. reported a higher long-term complication rate of 10–12%, primarily involving adhesive bowel obstruction and wound-related issues, our findings showed a comparatively lower incidence and different complication profile. [17]. Notably, patients requiring reoperation (e.g., for a burst abdomen) were managed without access to paediatric intensive care units, advanced wound care materials, or techniques like staged closure. These limitations elevate postoperative risk and point to the critical need for improved perioperative infrastructure in low-resource environments.

Our study's mortality rate was 3.5%, involving two neonates with volvulus and intestinal gangrene. Jabbar et al. reported a higher mortality rate of 8.8%, while El-Gohary et al. found rates as high as 10% over 10 years [14,17]. Variations may stem from differences in sample size, inclusion criteria, or the presence of associated congenital anomalies. Consistent across studies, however, is that mortality is strongly associated with delayed diagnosis and the presence of volvulus with gangrenous bowel [6,9,15].

Conclusion

Neonates presenting with bilious vomiting should be considered to have intestinal malrotation until proven otherwise and must receive urgent medical evaluation. This study demonstrates that, despite delayed presentation and limited diagnostic and surgical resources, intestinal malrotation can still have favorable outcomes in Sudan when managed appropriately.

However, delayed diagnosis and referral remain significant contributors to increased morbidity and mortality. Improving early detection requires enhanced awareness among parents, general practitioners, and paediatricians regarding the critical nature of bilious vomiting and the importance of early referral. Strengthening referral systems, investing in basic diagnostic tools such as upper gastrointestinal contrast studies, and ensuring timely surgical intervention are essential steps to improve outcomes.

Future research should focus on developing low-cost, efficient diagnostic protocols tailored for resource-limited settings, as well as evaluating long-term outcomes of patients with malrotation and volvulus. This study adds to the growing body of literature emphasizing the need for context-specific strategies in managing surgical emergencies in low -income countries.

Limitations

This study is limited by its retrospective design and the relatively small sample size, which may affect the generalizability of the findings. Prospective, multicenter studies are recommended to validate these results and explore broader systemic challenges.

Conflict of Interest

The authors declare no conflict of interest, financial or otherwise, related to the subject matter or materials discussed in this manuscript.

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