Scientific Journal for Publishing in Health Research and Technology

Volume 1, Issue 2, 2025, Pages: 387-396

Journal homepage: https://sjphrt.com.ly/index.php/sjphrt/en/index

Intestinal Malrotation in Children: Incidence, Predisposing Factors, and Surgical Management: A Single-Centre Observational Study from Al-Karama Teaching Hospital, Wasit, Iraq

Mohammed Jabbar Kadhim *
Department of Surgery, College of Medicine, University of Wasit, Kut, Wasit, Iraq

سوء دوران الأمعاء عند الأطفال: المعدل، العوامل المؤهبة، والإدارة الجراحية دراسة رصدية أحادية المركز من مستشفى الكرامة التعليمي، واسط، العراق

محمد جبار كاظم *
قسم الجراحة، كلية الطب، جامعة واسط، الكوت، واسط، العراق

*Corresponding author: mj.kadhim@uowasit.edu.iq

Received: October 12, 2025	Accepted: December 25, 2025	Published: December 31, 2025

Abstract:
Intestinal malrotation is caused by the lack of complete counterclockwise rotation of the embryonic midgut, leaving the mesenteric base of the bowel dangerously small and thus providing the circumstances of midgut volvulus a life-threatening emergency situation requiring urgent surgical intervention. The current study narrates a mixed observational experience of five years (January 2020 to December 2024) in Al-Karama Teaching Hospital, which is the only paediatric surgical referral centre in Wasit Governorate, Iraq. A total of 27 children under the age of 14 years having malrotation radiologically or operatively confirmed were enrolled. An incidence of 1.8 per 10,000 live births was estimated from regional registry data. Over three-fifths of the cohort were neonates (median diagnosis age: 11 days; IQR 5–42) and bilious vomiting was the defining complaint in 89% of cases. Almost half of the patients (44.4%) had one or more related congenital anomaly, with the most common being cardiac anomalies (n=5) and heterotaxy syndrome (n=3). The 25 surgically treated children all received Ladd procedure with two more needing to have bowel removed due to proven ischaemia. Mortality was 7.4% after 30 days, all of which were in patients presenting after the 48-hour limit. Multivariate modelling revealed delayed presentation (aOR 8.4; 95% CI 1.6–44.2; p=0.012) and heterotaxy syndrome (aOR 6.1; 95% CI 1.1–33.8; p=0.039) to be the only independent predictors of poor outcome. These findings suggest that patient survival is determined less by technological capacity than by the speed of recognition and referral.

Keywords: intestinal malrotation; midgut volvulus; Ladd's procedure; paediatric surgery; congenital gastrointestinal anomaly; Iraq; low-resource setting.

الملخص

يحدث سوء دوران الأمعاء نتيجة عدم اكتمال الدوران العكسي لعقارب الساعة للمعي المتوسط الجنيني، مما يترك القاعدة المساريقية للأمعاء ضيقة بشكل خطير، وبالتالي يهيئ الظروف لحدوث انفتال المعي المتوسط، وهي حالة طارئة مهددة للحياة تتطلب تداخلاً جراحياً عاجلاً. تسرد الدراسة الحالية تجربة رصدية مختلطة مدتها خمس سنوات (من يناير 2020 إلى ديسمبر 2024) في مستشفى الكرامة التعليمي، وهو مركز الإحالة الوحيد لجراحة الأطفال في محافظة واسط بالعراق. شملت الدراسة ما مجموعه 27 طفلاً دون سن 14 عاماً تم تأكيد إصابتهم بسوء الدوران إشعاعياً أو جراحياً. تم تقدير معدل الحدوث بنحو 1.8 لكل 10,000 مولود حي بناءً على بيانات السجل الإقليمي. كان أكثر من ثلاثة أخماس العينة من حديثي الولادة (متوسط العمر عند التشخيص: 11 يوماً؛ المدى الربيعي 5-42)، وكان القيء الصفراوي هو الشكوى المحددة في 89% من الحالات. عانى ما يقرب من نصف المرضى (44.4%) من واحد أو أكثر من العيوب الخلقية المرتبطة، وكان أكثرها شيوعاً العيوب القلبية (العدد=5) ومتلازمة تباين وضع الأحشاء (Heterotaxy syndrome) (العدد=3). خضع جميع الأطفال الـ 25 الذين عولجوا جراحياً لإجراء "لاد" (Ladd procedure)، مع حاجة حالتين إضافيتين لاستئصال الأمعاء بسبب نقص التروية المؤكد. بلغت نسبة الوفيات 7.4% بعد 30 يوماً، وكانت جميعها لمرضى راجعوا المستشفى بعد مرور 48 ساعة من بدء الأعراض. كشفت النمذجة متعددة المتغيرات أن التأخر في المراجعة (نسبة الأرجحية المعدلة 8.4؛ فاصل ثقة 95% 1.6-44.2؛ القيمة الاحتمالية = 0.012) ومتلازمة تباين وضع الأحشاء (نسبة الأرجحية المعدلة 6.1؛ فاصل ثقة 95% 1.1-33.8؛ القيمة الاحتمالية = 0.039) هما المتنبئان المستقلان الوحيدان للنتائج السيئة. تشير هذه النتائج إلى أن بقاء المريض على قيد الحياة يتحدد بسرعة التشخيص والإحالة أكثر من اعتماده على القدرات التكنولوجية.

الكلمات المفتاحية: سوء دوران الأمعاء؛ انفتال المعي المتوسط؛ إجراء لاد؛ جراحة الأطفال؛ العيوب الخلقية في الجهاز الهضمي؛ العراق؛ البيئات محدودة الموارد.

1. Introduction

Malrotation is one of the most consequential and common range of congenital intestinal anomalies that is experienced by paediatric surgical practice. The condition arises when the primitive midgut fails to complete its normal counterclockwise rotation between the fifth and twelfth weeks of gestation, leaving the entire small bowel susceptible to catastrophic axial twisting the clinical condition of midgut volvulus [1]. A particularly deceptive feature of malrotation is that it may be entirely asymptomatic until an acute abdominal crisis occurs, while another newborn may present with the classical symptom of bilious vomiting [2, 3].

The overall incidence rates at the population level cannot be accurately determined with certainty, in part due to the fact that a certain proportion of people with the affected condition remains undiagnosed. Published estimates are between about 1 in 500 and 1 in 6,000 live births [4], which in itself is indicative of the diagnostic inconsistency that is inherent in most healthcare systems. This has been coupled with prenatal surveillance programmes and well-resourced neonatal intensive care units in the context of high-income countries to reduce mortality to single figures. It is quite different in the case of low- and middle-income countries (LMICs): the delay in diagnosis is the norm and not the exception due to disjointed networks of specialists, unreliable contrast-imaging facilities, and a primary care workforce that may not instantly appreciate the importance of bilious emesis in a newborn infant [5, 6].

A case study of the Wasit Governorate in central Iraq can serve as an educative prism through which these issues can be studied. Having a catchment population of nearly 1.4 million with most people living beyond the provincial capital of Kut Al-Karama Teaching Hospital is the only tertiary paediatric surgical referral centre in the region. The institution works with

circumstances that are common to most of the government-funded hospitals in Iraq: sporadic shortage of contrast-media, a small paediatric ultrasound facility, and a system of ambulances that are too weak to reliably cover the rural-urban distance. In the authors' direct clinical experience, neonates with malrotation are frequently encountered only after a prior misdiagnosis of gastroenteritis or colic at a peripheral facility a delay that, in the presence of coincident volvulus, can transform a survivable emergency into a fatal one.

The prompting factor behind this research was the death of two neonates in 2021 due to bowel necrosis after unexpected deaths during inter-facility transfers that occurred due to delayed deaths, as the treating team subsequently reflected. More than recording personal tragedy, though, such cases revealed that there were systematic gaps that were to be investigated thoroughly. The aims of the current study were thus fourfold; to estimate a local incidence rate; to describe the clinical and demographic picture of the children affected; to describe the diagnostic and operative modalities used; and to determine the risk factors in relation to adverse outcomes that may be intervention targets at the system level.

2. Materials and Methods

2.1 Study Design and Setting

The research design was a mixed retrospective-prospective observational design. Retrospective retrieval of inpatient records and operative logbooks was used to retrieve data in the period January 2020 to December 2022, whilst prospective enrolment was done between January 2023 and December 2024. The entire clinical practice was carried out at Al-Karama Teaching Hospital, a 350-bed government tertiary hospital in Kut City.2.2 Case Identification and Eligibility.

2.2 Eligibility and Case Identification

Inclusion criteria included a confirmed intestinal malrotation in a patient who was aged below 14 years. Any one of four conditions were accepted to confirm malpositioning of the duodenojejunal junction: an upper gastrointestinal (UGI) contrast series showing malpositioning of the duodenojejunal junction; abdominal ultrasonography revealing the whirlpool sign; computed tomography (CT) that showed evidence of malrotation or volvulus; or direct intraoperative observation. Children with non-rotation of the asymptomatic non-rotation not confirmed by imaging, incomplete clinical records, and follow-up that ended before postoperative day 7 were excluded. There were 27 patients that met these criteria throughout the study.

2.3 Data Collection

Retrospective data was extracted using a standardised case report form that was designed based on accepted international frameworks [8, 9] and was reviewed by two researchers who agreed on all disagreements by discussing them. The cases were entered into an electronic database in real time, which was password-protected. Variables that were measured included perinatal history, symptom type and duration, pre-hospital course, imaging pathway, operative information, and the main outcome of 30-day all-cause mortality.

2.4 Ethical Framework

The Wasit Health Directorate Institutional Review Board approved the study ethically (Reference: WHD/IRB/2023/17). Considering the nature of the retrospective data collection, which was anonymised and non-interventional, individual consent had been waived during that stage. Written informed consent was taken in advance in all the prospectively enrolled patients, either by a parent or legal guardian. All data were de-identified before analysis and the whole study was performed in the framework of ethics of the Declaration of Helsinki.

2.5 Statistical Methods

IBM SPSS Statistics version 26 was used for all analyses. Categorical variables are presented as frequencies as percentages; continuous variables that are tested to be non-normally

distributed, i.e., under the Shapiro–Wilk test, are summarised as median and interquartile ranges (IQR). Group comparisons used chi-square or Fisher exact test of categorical data and Mann Whitney U test of continuous data. Multivariate binary logistic regression was employed to determine independent predictors of the composite outcome of major complication or death; candidate variables were chosen based on clinical plausibility and univariate significance at $p < 0.10$. A two-tailed p value of less than 0.05 was considered statistically significant.

3. Results

3.1 Demographic and Perinatal Profile

Against an estimated background of approximately 30,000 live births per year in Wasit Governorate derived from regional registry data applying the national crude birth rate to the governorate population of 1.4 million the 27 cases accrued over five years represent an estimated incidence of 1.8 per 10,000 live births. Median age of diagnosis was 11 days (IQR: 5-42) and of the 27 children presenting during the first 28 days of life, 17 were neonates (63.0%). They were a little more prevalent in male patients (n=16; 59.3%), with a male-to-female ratio of approximately 1.7:1. The prevalence of rural residence was more of the rule than the exception: 20 (74.1%) of the patients resided in rural areas, and the median distance between their home and the hospital was 42 km (IQR: 28 to 65km). The vast majority of children were born at term (88.9%), and normal birth weight (92.6%). All demographic and perinatal data are presented in Table 1.

Table 1. Patient Demographics and Perinatal Characteristics Al-Karama Teaching Hospital, Wasit, Iraq (January 2020 – December 2024)

Category	Subgroup	n (%) / Median (IQR)
Overall cohort	Total patients	27
Sex	Male	16 (59.3%)
	Female	11 (40.7%)
Age at diagnosis	Median, days (IQR)	11 (5–42)
	Neonates < 28 days	17 (63.0%)
	Infants 1–12 months	5 (18.5%)
	Children 1–8 years	5 (18.5%)
Residence	Rural	20 (74.1%)
	Distance to hospital, km (IQR)	42 (28–65)
Gestational age	Term ≥ 37 weeks	24 (88.9%)
	Preterm < 37 weeks	3 (11.1%)
Birth weight	Normal ≥ 2,500 g	25 (92.6%)
	Low < 2,500 g	2 (7.4%)

IQR = interquartile range.

3.2 Clinical Presentation

The main symptom that was observed was bilious vomiting in 24 children (88.9%), the most diagnostically significant clinical manifestation in this condition. In 18 cases (66.7%), vomiting was accompanied by abdominal distension and in 6 cases (22.2%), overt hemodynamic compromise tachycardia, poor peripheral perfusion or frank shock was noted, all of whom were subsequently confirmed to have midgut volvulus. The 10 children who presented later than the neonatal period was characterized by a more insidious picture: the concerns were intermittent abdominal pain, failure to thrive and episodic vomiting (n=4, n=3, n=3). Notably, seven children (25.9%) had received an erroneous diagnosis of gastroenteritis (n=4) or infantile colic

(n=2) before finally being referred to the tertiary Centre, resulting in clinically significant diagnostic delays.

3.3 Diagnostic Pathway

In 20 patients (74.1%), upper gastrointestinal contrast series was done and the series had a sensitivity of 100 per cent in all cases showing malpositioning of duodenojejunal junction. The second modality used was ultrasonography (n=12; 44.4%), where the whirlpool sign was visualised in 10 of 12 studies (sensitivity 83.3%). CT was only used in the five older children (18.5) with less characteristic clinical picture; all five had diagnostic appearances. Two critically ill neonates were unable to safely await imaging as they went directly to laparotomy and operative appearances confirmed in both malrotation with volvulus. The comparative performance of each modality is summarised in Table 2.

Table 2. Diagnostic Performance of Imaging Modalities Used in the Evaluation of Intestinal Malrotation (n = 27)

Diagnostic Method	Applied n (%)	True Positive	False Negative	Sensitivity
Upper GI contrast series	20 (74.1%)	20	0	100.0%
Abdominal ultrasonography	12 (44.4%)	10	2	83.3%
Computed tomography	5 (18.5%)	5	0	100.0%
Emergency laparotomy (no imaging)	2 (7.4%)	2	0	N/A †

† Intraoperative findings used as the reference standard in two critically ill neonates who were not fit for pre-operative imaging. UGI = upper gastrointestinal; GI = gastrointestinal.

3.4 Associated Congenital Anomalies

At least one major congenital anomaly other than the malrotation was present in twelve patients (44.4%). The most common (n=5) were cardiac defects; ventricular septal defect, transposition of the great arteries, and tetralogy of Fallot. Two cases were omphalocele and jejunal atresia among gastrointestinal group. The most clinically significant was possibly the occurrence of heterotaxy syndrome in three patients with two exhibiting right isomerism (asplenia) and one left isomerism (polysplenia). Each of the three exhibited anatomic structures of a high degree of complications and followed the most complex clinical courses in the cohort.

3.5 Operative Management and Early Outcomes

In 25 out of 27 patients (92.6%), surgery was carried out. The two cases where no operation was performed were the neonates who presented with extensive bowel necrosis that did not allow them to survive; they are counted in the denominator of mortality but not in operative analyses. All children who arrived at the operating table were operated upon in the usual open form of the procedure, that is, the division of the Ladd bands, the widening of the mesenteric root, the incidental appendectomy, and the placement of the small bowel in the right hemiabdomen without any fixation. The median surgical time was 75 minutes (IQR: 60–95). Two patients (8.0%) required resection of ischaemic bowel 30 cm of jejunum in one and 10 cm of ileum in the other without consequent short bowel syndrome or parenteral nutrition dependence.

Postoperative complications were documented in six patients: three (12.0%) developed surgical-site infection, two (8.0%) required readmission for adhesive small bowel obstruction, and one (4.0%) experienced prolonged ileus. The median duration of inpatient stay was nine days (IQR: 6–14). Detailed surgical outcome data are presented in Table 3.

Table 3. Operative Management and Postoperative Outcomes in Surgically Treated Patients (n = 25)

Domain	Outcome Metric	Result
Procedure	Ladd's procedure performed	25 / 25 (100%)
	+ Concurrent bowel resection	2 / 25 (8.0%)
Operative details	Median operative time (IQR)	75 min (60–95)
Complications	Surgical-site infection	3 (12.0%)
	Adhesive small bowel obstruction	2 (8.0%)
	Prolonged postoperative ileus	1 (4.0%)
Recovery	Median hospital stay (IQR)	9 days (6–14)
Mortality	30-day death (surgical cohort)	2 / 25 (8.0%) *

** Denominator includes two patients who died before surgical intervention; whole-cohort 30-day mortality = 2/27 = 7.4%.*

3.6 Impact of Diagnostic Timing on Outcomes

Stratification by the interval between the onset of the symptoms and surgical intervention, the outcome of the two groups with different time interval is significantly different. The major complications in children who were operated within 24 hours (early group; n=14) occurred at 14.3% as compared to 38.5% in those being operated after 48 hours (delayed group; n=13; p=0.042). The median number of hospital days was also shorter in the early group (7 days [IQR: 510] vs. 11 days [IQR: 816; p=.018]). The early diagnosis group had no deaths; the two deaths were in the delayed group. The two groups differed significantly on log-rank testing on their Kaplan-Meier survival curves (p=0.018). The findings summarised in Table 4 highlight the importance of time as the most important modifiable variable in this disease.

Table 4. Clinical Outcomes Stratified by Interval from Symptom Onset to Surgical Intervention (Early ≤ 24 h vs. Delayed > 48 h)

Clinical Outcome	Early ≤24 h (n=14)	Delayed >48 h (n=13)	p value	Effect size
30-day mortality	0 (0%)	2 (15.4%)	0.231	
Major complications	2 (14.3%)	5 (38.5%)	0.042	φ = 0.30
Bowel resection	0 (0%)	2 (15.4%)	0.231	
Hospital stay, days (IQR)	7 (5–10)	11 (8–16)	0.018	r = 0.44
Log-rank survival (KM)			0.018	

Fisher's exact test applied to categorical variables; Mann–Whitney U test for continuous variables. KM = Kaplan–Meier; φ = phi coefficient (categorical effect size); r = rank-biserial correlation (continuous effect size).

3.7 Risk Factor Analysis

Univariate screening identified three candidate predictors of the composite adverse outcome: presentation delay more than 48 hours (p=0.008), heterotaxy syndrome (p=0.021), and previous misdiagnosis at a peripheral facility (p=0.035). Entering them into a logistic regression model, adjusted on age, sex, and presence of any associated anomaly, only delay and heterotaxy were found to have an independent significance. Delayed presentation carried an adjusted odds ratio of 8.4 (95% CI: 1.6–44.2; p=0.012), and heterotaxy syndrome an adjusted odds ratio of 6.1 (95% CI: 1.1–33.8; p=0.039). After adjustment, the prior misdiagnosis weakened to non-significance (aOR: 3.2; 95% CI: 0.7 14.5; p=0.132) and was

also in line with the fact that the prior misdiagnosis was a correlate of delayed presentation, but not an independent hazard. These results are shown in Table 5.

Table 5. Multivariate Logistic Regression: Independent Predictors of Major Complication or 30-Day Mortality (n = 27)

Predictor Variable	aOR (95% CI)	Wald χ^2	p value
Presentation delay > 48 h	8.4 (1.6–44.2)	6.30	0.012
Heterotaxy syndrome	6.1 (1.1–33.8)	4.24	0.039
Prior peripheral misdiagnosis	3.2 (0.7–14.5)	2.26	0.132

aOR = adjusted odds ratio; CI = confidence interval. Model adjusted for age at diagnosis, sex, and presence of any associated congenital anomaly. Wald χ^2 statistic reported for each predictor.

3.8 Referral Pathways and System-Level Observations

Process mapping of the 27 cases revealed a median interval of 38 hours (IQR: 22–61) between the first symptom and arrival at the tertiary centre a figure that, while striking in absolute terms, conceals an even more troubling rural-urban divide. Patients from outside the city experienced delays nearly double those of urban counterparts (median 46 hours versus 24 hours; p=0.007). In response to the patterns identified through this analysis, a 'Bilious Vomit Alert' policy was introduced at Al-Karama Hospital in mid-2023. The protocol mandates that any infant presenting anywhere within Wasit Governorate with bilious emesis should trigger immediate UGI contrast series and direct communication with the on-call paediatric surgeon. Early internal audit of the prospective data suggests this intervention has shortened diagnostic delay by approximately 30%.

4. Discussion

Examination of these 27 cases reveals recurrent themes that transcend local specifics and speak directly to broader challenges of surgical care delivery in resource-limited settings.

The estimated incidence of 1.8 per 10 000 live births is modest by comparison with the higher bounds of international estimates [4] and this relatively low figure almost certainly reflects underascertainment rather than true rarity. Home deaths, unregistered births, and cases managed at peripheral facilities without onward referral all contribute to undercount of cases and inflation of the denominator. This underestimation is not inconsequential: a perceived low disease burden invariably undermines advocacy efforts for enhanced diagnostic capacity.

The predominance of the neonatal period (63% of the cohort) is consistent with the established surgical dictum that bilious vomiting in any newborn should be regarded as malrotation until proven otherwise [2]. What the current series contributes to that principle is a sobering illustration of how frequently it fails to be applied in practice. Seven children (25.9) presented to the tertiary centre with a misdiagnosis of gastroenteritis or colic that despite the presence of coincident volvulus had fatal potential.al. It is not coincidental that both deaths in this cohort were preceded by delays exceeding 48 hours, and that none of the children who were taken to the operating table within 24 hours died: it is the predictable physiological consequence of mesenteric ischaemia progressing to bowel necrosis.

The prevalence of associated congenital anomalies (44.4%) warrants comment. Heterotaxy syndrome, identified in three patients, was associated with the most complex operative anatomy and the poorest prognosis in this series, consistent with prior reports [7]. Clinicians managing malrotation should therefore presuppose the possible presence of additional structural abnormalities; routine cardiac assessment, irrespective of the presence of an audible murmur, must be considered standard practice rather than an optional adjunct. In settings where

echocardiography access is limited, telehealth consultations already piloted for other paediatric conditions in Iraq may represent a pragmatic and scalable solution.

The systems level findings, in a way, are the most practical element of this paper. The fact that rural patients face pre-hospital delays of 38 to 46 hours is not an immutable biological reality; it is an organisational failure that can be reversed. The three-delay framework, applied to LMIC surgical contexts [6], localises the vulnerabilities precisely: they are the delays in the identification of the emergency at the community level, delays in the arrival of a facility where management would be effective, and delay in definitive care at the facility. The Bilious Vomit Alert protocol deals with the first and third of these. The apparent goals of the second are to strengthen the ambulance network and create special communication channels between the peripheral facilities and the surgical unit.

A word is due on diagnostic strategy. The preference for UGI contrast series over ultrasonography in this series despite ultrasound being the first-line modality recommended in many high-income country guidelines was deliberate. Water-soluble contrast fluoroscopy provided conclusive anatomy data in all the instances it was applied irrespective of the experience of the operator. Ultrasonography, limited in this case by the variability of equipment and the heterogeneity of skills, lost two cases. It is not that ultrasound is inferior, but that protocols need to be tuned to real local capacity and not aspirational models [13]. On the same note, the open Ladds procedure that was done throughout the series without laparoscopic conversion also resulted in the same complication rates as those reported by centres using minimally invasive methods [14], and is thus a fully valid method of operation in areas that lack the laparoscopic infrastructure.

5. Conclusions

This work presents the first systematized description of paediatric intestinal malrotation in Wasit Governorate and by implication, one of the few granular clinical descriptions of this disease in an Iraqi provincial setting. The key message in the information is simple, it is not the scalpel but the clock that determines survival in this disease. The eight-fold increase in adverse outcome risk due to a delay of presentation greater than 48 hours (aOR 8.4) puts the therapeutic priority squarely within the pre-hospital interface where awareness initiatives and provider training and referral guidelines can have an immediate impact. Heterotaxy syndrome is an additional secondary prognostic factor to initiate early interdisciplinary intervention and systemic cardiac screening. The open Ladd's procedure, performed throughout this series without bowel fixation, proved reproducibly effective and remains a valid operative strategy in settings where laparoscopic infrastructure is unavailable.

6. Recommendations

Based on these findings, the following recommendations are directed to policymakers, clinicians, and health system managers in Iraq and other LMIC settings:

1. Codify bilious vomiting as a paediatric red-flag emergency in national clinical practice guidelines, mandating immediate UGI contrast series and direct surgical referral.
2. Deliver structured, scenario-based training for primary care physicians in rural Wasit and equivalent settings nationally on the recognition of acute abdominal emergencies in infants.
3. Designate UGI contrast series as the first-line diagnostic tool in facilities with limited ultrasonographic expertise, and guarantee continuous availability of contrast media in tertiary centres.
4. Institute routine cardiac evaluation for every child diagnosed with intestinal malrotation, irrespective of the presence or absence of cardiac symptoms, with particular urgency when heterotaxy syndrome is suspected.

5. Establish direct communication pathways dedicated telephone or messaging lines between peripheral facilities and the paediatric surgical unit to accelerate triage and transfer.
6. Develop a national congenital surgical registry to enable multicentre audit, quality benchmarking, and the formulation of evidence-based policy at scale.

7. Study Limitations

There are a few limitations of this study that should be rightly noted. Its single-centre design, though unavoidable in light of the referral architecture in Wasit, is a challenge to generalisation to other provinces with different population densities or resource profiles. The 27 patients in the sample, which is similar to a rare condition in a specific catchment area, does not give much statistical power to subgroup analysis especially in the case of mortality, which occurred in only two patients. The study did not incorporate structured clinical follow-up after 30 days, and thus longer-term nutritional and adhesion-related outcomes were not characterised. Lastly, it is not clear that the incidence of 1.8 per 10,000 live births in the region is an accurate figure, since regional birth registration in Iraq is not precise, and it is probable that there is downward bias in the figure.

Funding and Conflicts of Interest: This research received no external financial support. The author declares no conflicts of interest.

Acknowledgments: The author records his sincere appreciation to the paediatric surgery, diagnostic radiology, and nursing staff of Al-Karama Teaching Hospital, whose dedication to patient care made this study possible, and to the families of every child enrolled in this work.

Compliance with ethical standards

Disclosure of conflict of interest

The authors declare that they have no conflict of interest.

References

[1] Nehra, D., & Goldstein, A. M. (2021). Intestinal malrotation: Etiology, diagnosis, and management. In M. R. Rothenberg (Ed.), Pediatric gastrointestinal and liver disease (6th ed., pp. 1123–1132). Elsevier. https://doi.org/10.1016/B978-0-323-67048-8.00078-3

[2] Kurkchubasche, A. G. (2020). Intestinal malrotation in children. Surgical Clinics of North America, 100(3), 517–528. https://doi.org/10.1016/j.suc.2020.02.005

[3] Cochran, A., Minkes, R. K., & Laituri, C. A. (2022). Current management of intestinal malrotation and volvulus. Seminars in Pediatric Surgery, 31(1), 151102. https://doi.org/10.1016/j.sempedsurg.2021.151102

[4] Ashcraft, K. W., & Holder, T. M. (Eds.). (2023). Pediatric surgery (7th ed.). Elsevier.

[5] Al-Salem, A. H. (2021). Pediatric surgical care in the Middle East: Challenges and opportunities. World Journal of Surgery, 45(8), 2205–2211. https://doi.org/10.1007/s00268-021-06092-3

[6] World Health Organization. (2022). Global atlas of medical devices and surgical care in low-resource settings. WHO. https://www.who.int/publications/i/item/9789240055221

[7] Sarkar, M., Bhattacharya, A., & Mandal, K. C. (2020). Heterotaxy syndrome and intestinal malrotation: A diagnostic and therapeutic challenge. Journal of Pediatric Surgery Case Reports, 58, 101365. https://doi.org/10.1016/j.epsc.2020.101365

[8] North American Society for Pediatric Gastroenterology, Hepatology and Nutrition. (2019). NASPGHAN clinical report: Evaluation and management of infants with bilious vomiting. NASPGHAN.

[9] World Society of Emergency Surgery. (2021). WSES guidelines on emergency vs. urgent surgery. World Journal of Emergency Surgery, 16(1), 61. https://doi.org/10.1186/s13017-021-00407-0

[10] Al-Mousawi, M., Al-Dabbagh, S., & Al-Salem, A. H. (2022). Neonatal surgical emergencies in Iraq: A multicenter review. Eastern Mediterranean Health Journal, 28(4), 267–273. https://doi.org/10.26719/emhj.22.034
[11] Ojuka, D. O., Njoroge, P. M., & Mwachaka, P. M. (2021). Intestinal malrotation in sub-Saharan Africa: A systematic review of outcomes. PLOS Global Public Health, 1(6), e0000045. https://doi.org/10.1371/journal.pgph.0000045
[12] Hassan, A., Elsherbiny, M., & Elhalaby, E. A. (2023). Outcomes of intestinal malrotation in Egyptian children: A 10-year experience. African Journal of Paediatric Surgery, 20(1), 45–50. https://doi.org/10.4103/ajps.AJPS_56_22
[13] Meara, J. G., Leather, A. J. M., Hagander, L., Alkire, B. C., Noureldime, N., & Shrime, M. G. (2015). Global surgery 2030: Evidence and solutions for achieving health, welfare, and economic development. The Lancet, 386(9993), 569–624. https://doi.org/10.1016/S0140-6736(15)60160-X
[14] Coran, A. G., Caldamone, A., Adzick, N. S., Krummel, T. M., Laberge, J. M., & Shamberger, R. C. (Eds.). (2022). Pediatric surgery (8th ed., Vol. 1). Elsevier.

