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Clinical Profile and Surgical Outcomes of Neonates with Intestinal Obstruction: A Five-Year Retrospective Study at Al-Karami Teaching Hospital, Kut, Iraq

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الملف السريري والنتائج الجراحية للمواليد الجدد المصابين بانسداد الأمعاء: دراسة استعادية لخمس سنوات في مستشفى الكرامة التعليمي، الكوت، العراق

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Abstract:

Background: Neonatal intestinal obstruction (NIO) is one of the most severe emergencies of neonatal surgery. Early diagnosis and timely operative procedure is necessary to avoid life-threatening complications, such as bowel ischemia, perforation, and sepsis. Methods: It was a retrospective observational study that examined all neonate surgical cases (age ≤28 days) with confirmed mechanical intestinal obstruction of Al-Karami Teaching hospital, Al-Kut, Iraq, between January 2019 and December 2023. Demographics, ante-natal history, clinical presentation, radiographic studies, operative information, histopathologic diagnosis, post-operative complications and 30 days in-hospital mortality were analyzed in a systematic manner. Results A total of 87 neonates were recruited (male 59.8%, preterm 24.1%). Jejunoileal atresia (34.5%), malrotation with volvulus (21.8%), and Hirschsprung's disease (16.1%) were the most common etiologies. Obstructive anomalies were detected in 32.2% of cases by antenatal ultrasonography. Bilious vomiting (87.4%), abdominal distension (70.1%), and inability to pass meconium within 48 hours (56.3%) were the most common presenting features. Definitive surgical correction was done in all patients. The incidence of postoperative complications was 25.3% with wound infection (9.2%), sepsis (6.9%), and anastomotic leakage (5.7%) being the most common. The overall in-hospital mortality stood at 6.9%, with cases of malrotation/volvulus or obstruction caused by NEC occurring after 72 hours. Mean hospital stay was 12.4 ± 6.2 days. Conclusions: NIO continues to be an important contributor to neonatal morbidity and mortality in resource-restrained environments. In this institutional series morbidity and mortality rates are favorable to regional standards. Key interventions to improve outcomes include enhanced antenatal screening, early clinical recognition, and coordinated perioperative multidisciplinary care.

Keywords: Neonatal intestinal obstruction; jejunoileal atresia; malrotation with volvulus; Hirschsprung's disease; surgical outcomes; neonatal surgery; Iraq.

الملخص

الخلفية: يُعدّ انسداد الأمعاء عند المواليد الجدد من أشد حالات الطوارئ الجراحية في مرحلة حديثي الولادة، ويستلزم التشخيص المبكر والتدخل العلاجي السريع لتجنّب المضاعفات المهددة للحياة كإقفار الأمعاء والانثقاب والإنتان. **المنهجية:** استُعيدت السجلات الطبية لجميع المواليد الجدد (أعمارهم ≤28 يوماً) المُشخَّصين بانسداد أمعاء ميكانيكي في مستشفى الكرامة التعليمي بالكوت خلال الفترة من يناير 2019 إلى ديسمبر 2023. تضمّن جمع البيانات: البيانات الديموغرافية، التاريخ السابق للولادة، المظاهر السريرية، النتائج الشعاعية، البيانات الجراحية، والنتائج بعد العملية. **النتائج:** شُمِل 87 مولوداً؛ مثّل الذكور 59.8% والخُدَّج 24.1%. كانت الأسباب الأكثر شيوعاً رتقَ الصائم والدقاق (34.5%)، وسوء الدوران مع الالتفاف (21.8%)، وداء هيرشسبرونغ (16.1%). كُشفت شذوذات معوية بالتصوير الصوتي قبل الولادة في 32.2% من الحالات. بلغت نسبة المضاعفات 25.3%، والوفيات 6.9%، وكان متوسط مدة الإقامة 12.4 ± 6.2 يوماً. **الاستنتاج:** يرتبط انسداد أمعاء المولود بمعدلات مراضة ووفيات قابلة للمقارنة بالمعايير الإقليمية، وتبقى استراتيجيات التشخيص الجنيني المبكر والتدخل الجراحي السريع والرعاية متعددة التخصصات هي محاور التحسين الرئيسية.

الكلمات المفتاحية: انسداد الأمعاء عند المواليد؛ رتق الصائم والدقاق؛ سوء الدوران مع الالتفاف؛ داء هيرشسبرونغ؛ النتائج الجراحية؛ جراحة الأطفال؛ العراق.

1. Introduction

Neonatal intestinal obstruction (NIO) is defined as any mechanical impediment to the normal antegrade transit of intestinal contents occurring within the first 28 days of postnatal life. It constitutes one of the most frequent and surgically urgent emergencies of the neonatal period, with an estimated incidence of 1 in 2,000 to 5,000 live births, and accounts for a substantial proportion of neonatal intensive care unit (NICU) admissions worldwide [1, 2]. The condition encompasses a heterogeneous spectrum of congenital and acquired gastrointestinal anomalies, including luminal atresias, extrinsic bands, midgut malrotation with volvulus, and functional motility disorders such as Hirschsprung's disease [3, 4]. Collectively, NIO-related conditions represent the leading indication for neonatal laparotomy in most tertiary paediatric surgical centres [5].

The pathogenesis of NIO varies considerably by diagnosis. Intestinal atresias the most common aetiology of mechanical NIO are predominantly attributed to a late in-utero mesenteric vascular accident causing segmental ischaemia and subsequent luminal resorption, a mechanism originally proposed by Louw and Barnard [16] and subsequently validated in experimental models [14, 27]. Midgut malrotation, by contrast, results from an arrest or aberration in the normal 270-degree counter-clockwise rotation of the midgut during the sixth to tenth weeks of gestation, predisposing the neonate to Ladd's bands and potentially catastrophic midgut volvulus [17]. Hirschsprung's disease, which results from the failed craniocaudal migration of neural crest cells to populate the myenteric and submucosal plexuses of the distal bowel, represents the most common cause of functional colonic obstruction in the neonate [20, 21].

The clinical presentation of NIO is characteristically non-specific during the early neonatal period, mandating a high index of clinical suspicion. The classical symptom triad of bilious vomiting, abdominal distension, and failure to pass meconium within 48 hours of birth should prompt urgent investigation [4]. However, the sensitivity and specificity of individual features vary considerably by the anatomical level and nature of the underlying obstruction [23]. When diagnosis and surgical intervention are delayed beyond 48–72 hours, the risk of intestinal

ischaemia, bowel perforation, peritonitis, septic shock, and short bowel syndrome increases substantially, with corresponding adverse impact on both short- and long-term survival [5, 15]. Geographic location, genetic background, socioeconomic determinants and the presence of prenatal care infrastructure determine the etiological distribution and clinical profile of NIO. Routine second- and third-trimester fetal ultrasonography in high-income environments has significantly enhanced the antenatal identification of obstructive anomalies, facilitating the optimal perinatal planning and choice of delivery centre [6, 24]. By contrast, problems associated with suboptimal coverage of prenatal care, inadequate access to special fetal imaging, and insufficient neonatal surgical facilities remain a significant problem in many low- and middle-income nations such as Iraq, which collectively leads to an over-representation of late-presentation with advanced disease [7, 8].

Diagnostically, plain abdominal radiography is the mainstay of the initial examination, providing fast and inexpensive analysis of intestinal gas patterns and calibres [23]. Additional tests such as upper gastrointestinal contrast series, contrast enema, and abdominal ultrasonography will yield essential data regarding the degree, nature and functional importance of obstruction and are chosen on the basis of the suspected underlying aetiology [9, 19]. Surgical correction is the ultimate treatment of all but the most rare instances of mechanical NIO and an extensive repertoire of procedures including primary anastomosis and the Ladd procedure to pull-through surgery and staged ostomy creation all depending on the pathological diagnosis and haemodynamic state of the neonate [5, 13, 22].

Although neonatal surgery, perioperative care, and nutrition have improved greatly over the last thirty years, NIO remains coupled with a significant morbidity and mortality rate, especially in infants with very-low-birth-weight and those who manifest late with established intestinal gangrene or systemic sepsis [11, 15, 30]. Persistent multidisciplinary follow-up is required to provide support in the long term with sequelae such as short bowel syndrome, parenteral nutrition dependence, failure to thrive, and impaired neurodevelopment [12, 26]. The international literature on the Iraqi experience of neonatal surgery is limited in terms of published data. To fill such a gap, the current research was conducted to describe in detail the demographic profile, clinical presentation, diagnostic examination, operative treatment, and short-term outcomes of intestinal obstruction of neonates treated at Al-Karami Teaching Hospital in five consecutive years, as well as to compare the results with the current regional and international standards.

2. Materials and Methods

The study design and setting were as follows:

2.1 Study Design and Setting.

This was a retrospective, single-centre, observational study that was done in the Department of Paediatric Surgery, Al-Karami Teaching Hospital, Al-Kut, Wasit Governorate, Iraq a specified tertiary level referral centre of neonatal and paediatric surgical emergencies with a local catchment population of about 1.5 million. The research time frame was between January 1, 2019, and December 31, 2023 (60 consecutive months). The study complied with the ethical principles of the Declaration of Helsinki (2013 revision) [28], and data collection was approved by the Medical Research Ethics Committee of Al-Karami Teaching Hospital (Reference: MKTH-REC-2024-09).

2.2 Study Population

The study population included all neonates aged ≤28 days at presentation who had been admitted to the Department of Paediatric Surgery with a confirmed diagnosis of mechanical intestinal obstruction and had received definitive surgical treatment within the study period. The diagnosis was made on the basis of clinical assessment supported by radiological imaging and intraoperative identification and histopathological analysis where necessary. Cases were

identified retrospectively using the electronic medical records system and the surgical theatre logbooks; this two-source ascertainment strategy was employed to minimise ascertainment bias [13].

Inclusion criteria: (1) neonatal age of not more than 28 days at the time of presentation; (2) diagnosis of mechanical intestinal obstruction; and (3) definitive surgical treatment carried out at the facility of the study. Exclusion criteria: (1) functional bowel disorders that could be treated conservatively (e.g., meconium plug syndrome, transient neonatal ileus); (2) cases that were treated conservatively (that is, no operative intervention); and (3) cases with incomplete medical histories that could lead to the inability to extract adequate data.

2.3 Data Collection

The research team created a structured data extraction form which was piloted on ten records before full deployment. The following domains were systematically documented: (a) demographic data sex, gestational age, birth weight (grams), mode of delivery, and Apgar score at five minutes; (b) antenatal history maternal age, parity, presence of polyhydramnios, fetal bowel dilatation on ultrasonography, and relevant maternal comorbidities; (c) clinical presentation age at surgical referral (days), presenting symptoms, and pertinent physical examination findings; (d) diagnostic investigations imaging modalities utilized and key radiological findings; (e) operative data procedure type, intraoperative findings, obstruction level, and bowel viability status; (f) histopathological reports where tissue specimens were submitted; and (g) postoperative outcomes in-hospital complications, duration of hospital stay, and 30-day in-hospital mortality. Two investigators extracted all the data and cross-verified them to reduce transcription bias [13].

2.4 Diagnostic Evaluation Protocol

Clinical assessment including history and physical examination was performed on all neonates upon admission. Plain supine and erect (or lateral decubitus) abdominal radiography was obtained as the universal initial imaging investigation in all cases [23]. Upper gastrointestinal contrast series using water-soluble contrast medium was employed selectively in neonates with clinical or radiological suspicion of duodenal atresia or malrotation with midgut volvulus [17, 23]. Contrast enema was performed in cases of suspected distal mechanical obstruction particularly Hirschsprung's disease, colonic atresia, or low ileal obstruction to identify the transitional zone and calibre discrepancy diagnostic of aganglionic bowel [19, 20]. Abdominal ultrasonography was utilized as a complementary tool when intestinal perforation, free peritoneal fluid, or a palpable abdominal mass was clinically suspected [23].

2.5 Surgical Management

All enrolled neonates underwent definitive surgical correction. Operative strategy was determined by the underlying pathological diagnosis, anatomical level and extent of obstruction, degree of bowel viability at laparotomy, and haemodynamic stability of the neonate. Standard procedures included: resection with primary end-to-end anastomosis for jejunoileal atresia [14, 27, 30]; the Ladd procedure comprising division of peritoneal bands, broadening of the mesenteric base, appendicectomy, and repositioning of the bowel for malrotation with volvulus [17]; diamond-shaped duodeno-duodenostomy for duodenal atresia [18]; Swenson or transanal endorectal pull-through for Hirschsprung's disease [21, 25, 29]; and diverting colostomy or ileostomy as a staged approach in critically ill neonates or those with significant peritoneal contamination or haemodynamic instability [12]. All procedures were performed by, or under the direct supervision of, a consultant paediatric surgeon.

2.6 Statistical Analysis

Data were analyzed using IBM SPSS Statistics, version 26.0 (IBM Corp., Armonk, NY, USA). Given the descriptive nature of this study, no inferential statistical testing was applied. Categorical variables were summarized as absolute frequencies and proportional percentages. Continuous variables were expressed as mean ± standard deviation (SD). Subgroup

comparisons of hospital stay duration (with versus without complications) were performed using an independent-samples t-test, with significance set at $p < 0.05$.

3. Results

3.1 Demographic Characteristics

Out of the five years of study, 87 neonates were eligible and were enrolled in the study. There was a majority of male neonates (59.8% (n=52) of the cohort (male-to-female ratio: 1.49:1). Term neonates (gestational age ≥37 weeks) represented 75.9% (n = 66) of cases, while 24.1% (n = 21) were preterm (<37 weeks). The mean birth weight was 2,850 ± 510 g; mean age at the time of surgery was 4.2 ± 2.1 days; most of the surgeries were done within the first 72 hours of life, which showed the acute nature of the presentation (Table 1).

Table 1. Baseline Demographic Characteristics of Neonates with Intestinal Obstruction (n = 87)

Variable	n (%) or Mean ± SD
Sex Male	52 (59.8%)
Sex Female	35 (40.2%)
Male : Female Ratio	1.49 : 1
Preterm (<37 weeks' gestation)	21 (24.1%)
Term (≥37 weeks' gestation)	66 (75.9%)
Mean Birth Weight (g)	2,850 ± 510
Mean Age at Surgery (days)	4.2 ± 2.1
Caesarean Section Delivery	31 (35.6%)
Vaginal Delivery	56 (64.4%)
Mean Apgar Score at 5 min	7.1 ± 1.4

3.2 Etiology of Intestinal Obstruction

The most commonly diagnosed aetiology was jejunoileal atresia with a prevalence of 34.5% (n = 30). Malrotation with volvulus ranked second (21.8%, n = 19), followed by Hirschsprung's disease (16.1%, n = 14) and duodenal atresia (12.6%, n = 11). Rarer diagnoses consisted of meconium ileus (6.9% n=6), imperforate anus (4.6% n=4) and NEC-related obstruction (3.4% n=3), the latter only seen in preterm infants. Table 2 gives the entire etiological distribution.

Table 2. Etiological Distribution of Neonatal Intestinal Obstruction (n = 87)

Diagnosis	n (%)	Gestational Age (Preterm/Term)	M : F Ratio
Jejunoileal Atresia	30 (34.5%)	6 / 24	1.5:1
Malrotation with Volvulus	19 (21.8%)	4 / 15	1.7:1
Hirschsprung's Disease	14 (16.1%)	2 / 12	3.7:1
Duodenal Atresia	11 (12.6%)	5 / 6	1:1
Meconium Ileus	6 (6.9%)	2 / 4	1:1
Imperforate Anus	4 (4.6%)	0 / 4	3:1
NEC-Related Obstruction	3 (3.4%)	3 / 0	2:1
Total	**87 (100%)**	22 / 65	1.49:1

3.3 Antenatal Findings and Clinical Presentation

Antenatal ultrasonographic abnormalities consistent with intestinal obstruction were identified in 32.2% (n = 28) of cases. Polyhydramnios was the predominant prenatal finding (32.2%, n =

28), followed by fetal bowel dilatation (21.8%, n = 19). The remaining 67.8% (n = 59) of neonates had no prenatal diagnosis and presented postnatally with acute symptoms. Among postnatal features, bilious vomiting was the most prevalent symptom (87.4%, n = 76), followed by abdominal distension (70.1%, n = 61) and failure to pass meconium within 48 hours of birth (56.3%, n = 49). Poor feeding or lethargy was documented in 43.7% (n = 38) of cases. Complete antenatal and clinical data are presented in Table 3.

Table 3. Antenatal Ultrasonographic Findings and Postnatal Clinical Features (n = 87)

Feature	n (%)
ANTENATAL FINDINGS	
Polyhydramnios on maternal ultrasound	28 (32.2%)
Fetal bowel dilatation	19 (21.8%)
No antenatal diagnosis of obstruction	59 (67.8%)
POSTNATAL PRESENTING SYMPTOMS	
Bilious vomiting	76 (87.4%)
Abdominal distension	61 (70.1%)
Failure to pass meconium within 48 hours	49 (56.3%)
Poor feeding / lethargy	38 (43.7%)
Abdominal tenderness on examination	22 (25.3%)

3.4 Diagnostic Imaging

Plain abdominal radiography was universally performed in all 87 neonates (100%). Predominant radiological patterns included: multiple dilated bowel loops with air-fluid levels (jejunoileal and colonic obstructions); the pathognomonic 'double-bubble' sign in duodenal atresia; a 'corkscrew' appearance on upper GI series in malrotation with volvulus; and a transitional zone on contrast enema in Hirschsprung's disease. Contrast enema was employed as a complementary investigation in 56.3% (n = 49) of cases. Upper gastrointestinal contrast series was used in 16.1% (n = 14) of neonates with suspected proximal obstruction. Abdominal ultrasonography was performed in 25.3% (n = 22) of cases when perforation or free peritoneal fluid was suspected. Table 4 summarizes the diagnostic modalities employed.

Table 4. Diagnostic Imaging Modalities Employed in the Evaluation of Neonatal Intestinal Obstruction (n = 87)

Investigation	n (%)	Primary Indication	Key Radiological Finding
Plain Abdominal X-Ray	**87 (100%)**	All cases (first-line)	Air-fluid levels; double-bubble sign
Contrast Enema	49 (56.3%)	Distal obstruction / Hirschsprung's	Transitional zone; calibre discrepancy
Upper GI Contrast Series	14 (16.1%)	Duodenal atresia / Malrotation	Corkscrew sign; duodenal cut-off
Abdominal Ultrasound	22 (25.3%)	Suspected perforation / free fluid	Free fluid; bowel wall thickening

3.5 Operative Procedures Performed

Definitive surgical correction was carried out in all 87 neonates. Resection with primary end-to-end anastomosis was the most frequently performed procedure (39.1%, n = 34). The Ladd procedure was performed in 21.8% (n = 19) of cases. Swenson or transanal endorectal pull-through was undertaken in 16.1% (n = 14). Duodeno-duodenostomy was performed in 12.6%

(n = 11). Diverting colostomy or ileostomy was fashioned in 6.9% (n = 6) of critically ill neonates. Three patients (3.4%) underwent other specified procedures. The complete operative distribution is presented in Table 5.

Table 5. Operative Procedures Performed According to Underlying Pathology (n = 87)

Procedure	Underlying Diagnosis	n (%)	Primary/Staged
Resection & End-to-End Anastomosis	Jejunoileal Atresia	34 (39.1%)	Primary
Ladd's Procedure	Malrotation with Volvulus	19 (21.8%)	Primary
Swenson / Transanal Pull-Through	Hirschsprung's Disease	14 (16.1%)	Primary
Duodeno-Duodenostomy (Diamond)	Duodenal Atresia	11 (12.6%)	Primary
Diverting Colostomy / Ileostomy	Critically ill / Staged	6 (6.9%)	Staged
Other Procedures	Various	3 (3.4%)	Variable
Total		**87 (100%)**	

3.6 Postoperative Complications

Postoperative complications were recorded in 22 of 87 patients (25.3%). Wound infection was the most common complication (9.2%, n = 8), followed by sepsis (6.9%, n = 6), anastomotic leakage (5.7%, n = 5), and postoperative ileus (3.4%, n = 3). Complications were disproportionately concentrated among preterm neonates and those presenting beyond 72 hours with clinical evidence of systemic sepsis or intestinal ischaemia. All five cases of anastomotic leakage occurred following resection with primary anastomosis for jejunoileal atresia; each was managed by surgical re-exploration and diversion. Table 6 presents the complete complication profile.

Table 6. Postoperative Complications Following Surgical Management of NIO (n = 22 of 87, 25.3%)

Complication	n (%)	Management Strategy	Resolution
Surgical Site Infection	8 (9.2%)	Wound care ± antibiotics	All resolved
Culture-Confirmed Sepsis	6 (6.9%)	IV antibiotics + NICU support	4 resolved, 2 died
Anastomotic Leakage	5 (5.7%)	Re-exploration + diversion	All survived
Prolonged Postoperative Ileus	3 (3.4%)	Conservative management + TPN	All resolved
Total Complications	22 (25.3%)		

3.7 Clinical Outcomes and Mortality

The overall in-hospital mortality rate was 6.9% (n = 6). All six deaths occurred in neonates with either malrotation with volvulus (n = 3) or NEC-associated obstruction (n = 3), both conditions associated with extensive intestinal ischaemia and systemic septic shock at presentation. In five of the six fatal cases, the interval from symptom onset to surgical intervention exceeded 72 hours, reinforcing the critical prognostic significance of operative delay. The remaining 81 neonates (93.1%) were discharged in satisfactory clinical condition. Mean length of hospital stay was 12.4 ± 6.2 days. Neonates who developed postoperative

complications had significantly longer admissions (18.7 ± 7.1 days) than those without (10.2 ± 4.5 days; $p < 0.05$). Short-term outcome data are presented in Table 7.

Table 7. Short-Term Outcomes Following Surgical Management of Neonatal Intestinal Obstruction (n = 87)

Outcome Measure	Value
Discharged well (alive at discharge)	81 (93.1%)
In-hospital mortality (≤30 days post-surgery)	6 (6.9%)
Malrotation / volvulus	3 (3.4%)
NEC-related obstruction	3 (3.4%)
Overall postoperative complications	22 (25.3%)
Mean hospital stay all patients (days)	12.4 ± 6.2
Mean stay with postoperative complications (days)	18.7 ± 7.1
Mean stay without postoperative complications (days)	10.2 ± 4.5
p-value (stay with vs. without complications)	< 0.05

4. Discussion

This five-year retrospective institutional analysis provides a comprehensive clinical profile of 87 neonates with mechanical intestinal obstruction managed surgically at Al-Karami Teaching Hospital one of the principal tertiary neonatal surgical referral centres in southern Iraq. The findings are contextualized against the existing regional and international literature to identify areas of clinical strength and opportunities for targeted improvement.

4.1 Demographic Profile and Sex Distribution

The cohort demonstrated a clear male predominance (59.8%; male-to-female ratio 1.49:1), a finding consistent with multiple published series from diverse geographic and socioeconomic contexts. Gupta et al. [8] reported a male predominance of 62.3% in a decade-long Indian series, while Al-Salem [10] documented a figure of 58.4% across a ten-year Saudi cohort. Snyder and Langer [12] similarly reported male predominance across most NIO subtypes in a recent North American review. While the precise biological underpinning of this sex disparity remains incompletely elucidated, postulated mechanisms include sex-linked differences in intestinal rotational development, differential susceptibility to mesenteric vascular compromise, and potential referral biases in favour of male infants in certain sociocultural contexts [4].

The proportion of preterm neonates (24.1%) in the present cohort was somewhat lower than the 30–35% reported in series from comparable resource-limited settings [7, 8]. Prematurity was disproportionately represented, however, among neonates who developed postoperative complications and in-hospital mortality, consistent with its well-established role as an independent adverse prognostic factor in neonatal surgery [11, 15]. Very-low-birth-weight neonates are known to carry substantially higher risks of anastomotic failure, infectious complications, and prolonged ileus following bowel surgery [26, 30].

4.2 Etiological Distribution and Pathogenesis

Etiological ranking observed in the current study is very similar to the trends reported in the current international literature [1, 12]. The most common diagnosis was jejunoileal atresia (34.5%), consistent with it being the most common cause of NIO worldwide. Its pathogenesis is principally attributed to a late in-utero mesenteric vascular accident resulting in segmental intestinal ischaemia and resorption, as originally demonstrated by Louw and Barnard [16]. The morphological classification was subsequently refined by Dalla Vecchia et al. [14] into four atresia subtypes with distinct operative and prognostic consequences. Stollman et al. [15] in a Dutch cohort showed that even though mortality due to jejunoileal atresia has decreased (16%

to 3%), morbidity particularly short bowel syndrome and long-term dependence on parenteral nutrition has risen accordingly as short-term survival of more complex cases has improved.

The second and third most common conditions were malrotation with volvulus (21.8%) and Hirschsprung's disease (16.1%), respectively, consistent with epidemiological trends in the Middle East and South Asia [8, 10]. The Ladd procedure, first detailed by Ladd in 1936 [17], is the standard surgical approach to correct malrotation with volvulus; its principal objectives are reduction of the volvulus, division of Ladd's bands, broadening of the small bowel mesentery, and repositioning of the caecum to prevent recurrence. Hirschsprung's disease, in which the aganglionic segment is confined to the rectosigmoid in approximately 80% of cases [21], is best established by suction rectal biopsy demonstrating absence of ganglion cells [20]. In a systematic review of diagnostic modalities in Hirschsprung's disease, De Lorijn et al. [20] confirmed that suction rectal biopsy is the most sensitive (93%) and specific (98%) diagnostic modality, while contrast enema carries lower sensitivity (approximately 70–93%). The marked male predominance in Hirschsprung's disease in the current series (M:F ratio 3.7:1) is consistent with established epidemiological data [21].

The failure of the vacuolization of the solid epithelial cord phase of duodenal development during the fifth to sixth gestational week [18, 24] led to duodenal atresia, which comprised 12.6% of the cases. Its established correlation with trisomy 21 found in two out of eleven cases in this series highlights the need to have chromosomal evaluation in every neonate with duodenal obstruction. In a UK population-based study, Betetell et al. [24] found an associated Down syndrome rate of 28.6, which is greater than that in the current series, probably due to ethnic and genetic background differences. Instead of using side-to-side anastomosis, diamond-shaped duodeno-duodenostomy, initially described by Kimura et al. [18], has become the gold-standard repair and was used consistently in the current series.

4.3 Antenatal Detection and Clinical Presentation

The antenatal detection rate of intestinal obstructive anomalies in the present series (32.2%) is considerably lower than the 50–70% reported from centres in high-income countries with structured fetal anomaly screening programmes [6, 24]. Danzer et al. [6] demonstrated, in a comparative cohort study, that prenatal diagnosis of intestinal atresia was associated with a significantly shorter interval to surgical repair, lower rates of postoperative complications, and superior long-term nutritional outcomes. This finding underscores the clinical and operational value of investing in third-trimester fetal ultrasonographic surveillance in resource-constrained health systems such as those prevalent in Iraq.

Bilious vomiting was the cardinal presenting symptom in 87.4% of neonates a proportion consistent with the 80–92% range reported across comparable series [8, 10, 12] and should be regarded as a surgical emergency until intestinal obstruction is excluded, in keeping with established paediatric surgical principles [4, 5]. Failure to pass meconium within 48 hours, present in 56.3% of patients, was a particularly sensitive indicator of Hirschsprung's disease and distal atresias and should prompt immediate investigation with contrast enema when observed, as outlined in current clinical guidelines [20, 21].

4.4 Diagnostic Strategy

Plain abdominal radiography, universally employed in the present series, remains the essential first-line imaging modality in suspected NIO, providing rapid, cost-effective information regarding intestinal gas distribution, calibre, the presence of free intraperitoneal air, and pathognomonic patterns such as the double-bubble sign of duodenal atresia and multiple air-fluid levels of distal obstructions [23]. Vinocur et al. [23] recently provided a comprehensive radiological review of NIO patterns, confirming that the initial plain radiograph identifies the diagnosis or narrows the differential in more than 80% of cases when interpreted by an experienced radiologist in conjunction with clinical findings.

Contrast enema, used in 56.3% of cases, demonstrated high diagnostic utility in delineating distal obstructive lesions. Its role in demonstrating the transitional zone of Hirschsprung's disease — a calibre discrepancy between the narrow aganglionic segment and the dilated ganglion-containing bowel proximal to it — is well established, although sensitivity for short-segment disease may be as low as 60–70% on contrast enema alone, necessitating histopathological confirmation by suction rectal biopsy in all cases [19, 20]. In neonates with suspected meconium ileus, water-soluble contrast enema simultaneously served a diagnostic and therapeutic role, facilitating non-operative meconium evacuation in selected cases.

4.5 Surgical Outcomes and Postoperative Morbidity

This series has an overall postoperative complication rate of 25.3% which is comparable to the 20-30% in similar institutional series in developing countries [7, 8, 10] and somewhat greater than the 10-18% in high-income tertiary centres [12, 14]. Such a difference, most probably, demonstrates the accumulating impact of late presentation and insufficient perioperative monitoring resources, as well as the lack of specialized neonatal surgical intensive care units at our hospital. The most common complications of wound infection (9.2%), sepsis (6.9%), implies the necessity to strengthen the perioperative antimicrobial stewardship guidelines, and aseptic technique, which is consistent with the current neonatal surgical infection prevention recommendations [12].

Anastomotic leakage occurred in 5.7% (n = 5) of patients, all following resection and primary anastomosis for jejunoileal atresia, a rate consistent with the 4–8% reported in the neonatal surgical literature for high-risk neonatal bowel anastomoses [14, 15]. Dalla Vecchia et al. [14] identified calibre discrepancy between the dilated proximal and collapsed distal bowel as the principal technical risk factor for anastomotic failure in jejunoileal atresia, a finding that has driven the evolution of tapering enteroplasty and end-to-oblique anastomotic techniques. Spilde et al. [19] further noted that operative experience, bowel viability, and tissue tension at the anastomosis are independently predictive of leakage risk, emphasising the importance of senior surgical supervision in all neonatal intestinal reconstructions.

The overall in-hospital mortality rate of 6.9% compares favourably with the 8–15% reported from low- and middle-income country settings with similar resource constraints [7, 8, 10], and approaches the 4–6% mortality reported in specialized high-income neonatal surgical centres [1, 12]. Cole et al. [13] reported a 30-day mortality of 8.2% in a multi-institutional North American series of 2,006 neonates with intestinal obstruction, while Osifo and Osagie [7] documented 12.4% mortality in a West African cohort. The concentration of all six deaths in neonates with malrotation/volvulus or NEC-associated obstruction conditions characterized by rapid intestinal ischaemia and systemic inflammatory response and the predominance of late presentation (>72 hours) among fatalities corroborates the well-established, causal relationship between operative delay and mortality in NIO [5, 7, 12]. This underscores the urgency of community and primary healthcare education regarding the warning signs of neonatal intestinal obstruction and the imperative for rapid tertiary surgical referral.

4.6 Study Limitations and Strengths

There are a number of limitations to this research. First, its retrospective nature poses possible data incompleteness and prohibits standardized prospective data collection of single clinical variables. Second, the single-centre design, although offering internally reliable data, restricts the extrapolation of the results to the larger Iraqi or regional population. Third, the sample size (n = 87 in five years) is relatively small that limits statistical power of subgroups. Fourth, the lack of a control group and multi-variable regression analysis does not allow conclusive derivation of independent prognostic predictors. Fifth, available records were not able to retrieve long-term functional outcomes, neurodevelopmental parameters, and nutritional status of survivors.

Despite these shortcomings, this research has a number of strengths. It is, as far as the author is aware, the most detailed institutional study of neonatal intestinal obstruction in the literature of the region so far, filling a major gap in the literature on the subject in the region. The complete five-year consecutive case series design minimizes selection bias. All patients had available detailed operative and histopathological information, which guaranteed the accuracy of diagnosis. Dual-investigator data extraction and cross-verification enhanced data integrity. The results offer a critical baseline on which prospective institutional gains in antenatal screening, perioperative care, and referral pathways might be measured.

5. Conclusion

Neonatal intestinal obstruction is an emergency surgery with critical time requirement to avoid intestinal ischaemia, sepsis, and death by ensuring early clinical suspicion, radiological evaluation, and prompt definitive surgery. Jejunoileal atresia, malrotation with volvulus, and Hirschsprung disease were found to be the cause of 72.4% of the total cases in this five-year institutional series. Definitive surgical correction was made in all 87 neonates; postoperative morbidity was found to be 25.3% and total in-hospital mortality was found to be 6.9% which is reasonably comparable with current regional standards given the inherent resource limitations of the environment. This is supported by the fact that mortality is concentrated among the late-presenting neonates that have vascular compromise, thus supporting the importance of timely referral and early operative intervention.

Three priority interventions are identified: (1) strengthening antenatal ultrasonographic screening programmes to increase the prenatal detection rate of obstructive anomalies beyond the current 32.2%; (2) community and primary healthcare education to improve early recognition and facilitate urgent tertiary referral of neonates presenting with bilious vomiting or failure to pass meconium; and (3) pursuing multi-centre prospective studies with larger samples, standardised outcome definitions, extended follow-up, and multivariable prognostic modelling to validate the present findings, characterise long-term functional outcomes and quality of life in survivors, and inform the development of national neonatal surgical care standards and neonatal registries across Iraq and the broader Middle East region.

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Ethical Approval

Ethical approval was obtained from the Medical Research Ethics Committee of Al-Karami Teaching Hospital, Kut, Iraq (Reference: MKTH-REC-2024-09). The study was conducted in accordance with the Declaration of Helsinki (2013 revision) [28]. Individual patient informed consent was waived given the retrospective nature of the study and complete anonymization of all collected data.

Compliance with ethical standards

Disclosure of conflict of interest

The authors declare that they have no conflict of interest.

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