Original Article

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Intestinal Stoma Types, Indications and Complications in Pediatric Patients: A Three-year Single-center Experience with Necrotizing Enterocolitis as the Leading Indication

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Abstract

Aim: This study aimed to analyze the distribution, clinical indications, and complication rates of pediatric intestinal stomas in our institution, with a particular focus on identifying the predominant underlying pathologies and their correlation with stoma type selection.

Methods: This retrospective observational cohort study included 78 pediatric patients who underwent intestinal stoma surgery between June 2020 and June 2023. All patients aged 0-18 years who underwent stoma-creation surgery were identified through our hospital's data system and clinical surgery register and evaluated for age, sex, primary disease, timing of stoma-creation, stoma type and location, and stoma-related complications. Patients who underwent esophagotomies or gastrostomies were excluded from the study; only those with intestinal stomas were included.

Results: Eighty-one stomas were performed on 78 patients: 55 ileostomies (68%), 22 colostomies (27%), and 4 jejunostomies (5%). Divergent (44.5%) and loop (42%) stomas were the most common. Necrotizing enterocolitis (NEC) was the leading indication (30.7%, n=24), followed by Hirschsprung disease (23.1%, n=18), meconium ileus (11.5%, n=9), and anorectal malformations (ARM) (10.3%, n=8). The overall complication rate was 78.2%, with skin excoriation being most frequent (64.1%, n=50). Neonates constituted 48.7% of patients (n=38), and 72% of patients were under one year of age.

Conclusion: Unlike most pediatric series, in which ARM predominate, NEC was the leading stoma indication in our cohort, reflecting institutional characteristics, including the absence of a dedicated neonatal surgery unit. Ileostomy was the most frequently performed procedure. Stoma indications and types vary significantly according to regional factors and the institutional infrastructure.

Keywords: Ostomy, ileostomy, colostomy, enterostomy, child, infant, newborn

Introduction

Intestinal stomas, surgical openings connecting the gastrointestinal tract to the abdominal wall, represent critical life-saving interventions in pediatric surgery. The word "stoma" comes from the Greek word for "mouth" and means moving intestinal contents through an opening in the abdomen, either temporarily or permanently. These procedures serve multiple purposes in both emergency and elective surgical scenarios, including fecal diversion, bowel decompression, and protection of distal anastomoses. While adult stoma indications primarily include colorectal malignancies, inflammatory bowel disease, diverticulitis, and trauma, pediatric populations present distinct indication patterns dominated by congenital anomalies and neonatal emergencies (1-3). Contemporary pediatric surgical practice demonstrates evolving trends in stoma use, with institutional variations reflecting differences in patient populations, availability of neonatal intensive care resources, and surgical expertise (4,5).

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The predominant indications for pediatric intestinal stomas traditionally include anorectal malformations (ARM) and Hirschsprung disease (HD), accounting for the majority of cases in published series (6-8). However, acquired conditions, such as necrotizing enterocolitis (NEC), are increasingly significant indications, particularly in centers with high-volume neonatal intensive care units (9,10). Recent multicenter studies have highlighted substantial geographic and institutional variability in stoma patterns, with some centers reporting NEC as the leading indication, while others report ARM predominance (11-13). The selection of stoma type—whether loop, divided (divergent), or end configuration—and anatomical location (jejunum, ileum, or colon) depends on multiple factors, including underlying pathology, intestinal viability, surgeon preference, and institutional protocols. Contemporary evidence suggests that stoma-related complications remain common, ranging from 21% to 70% across series, with significant morbidity including prolapse, skin excoriation, stenosis, and fluid-electrolyte imbalances, which particularly affect younger patients (14-16).

We hypothesized that our institutional stoma patterns would differ from traditional literature reports due to the absence of a dedicated neonatal surgery unit and limited neonatal intensive care capacity, potentially resulting in a distinct distribution of underlying diagnoses and stoma types. Therefore, this study aimed to comprehensively analyze the types, indications, and complications of intestinal stomas performed at our pediatric surgery department over a three-year period. By characterizing our institutional experience, we seek to contribute to the understanding of how healthcare infrastructure and regional factors influence pediatric stoma surgery patterns, thereby providing valuable insights for resource allocation and surgical planning in similar clinical settings.

Materials and Methods

Compliance with Ethical Standards

This retrospective study was approved by the University of Health Sciences Türkiye, Basaksehir Cam and Sakura City Hospital Clinical Research Ethics Committee (approval number: 438, date: 27.09.2023). All procedures adhered to the ethical standards outlined in the 1964 Declaration of Helsinki and its subsequent amendments. The ethics committee waived the requirement for informed consent because the study was retrospective.

Study Design

This retrospective observational cohort study included all pediatric patients aged 0-18 years who underwent intestinal stoma-creation at our pediatric surgery department between June 2020 and June 2023. Patients were identified through systematic review of the hospital's electronic medical records system and the departmental surgical registry. Inclusion criteria were patients aged 0-18 years who underwent surgical creation of an intestinal stoma (jejunostomy, ileostomy, or colostomy) and had complete medical records available. Exclusion criteria were gastrostomies or esophagostomies, incomplete medical records, and stoma surgery performed at another institution (Figure 1).

Data Collection

Medical records were systematically reviewed to extract the following variables: patient demographics (age, sex), primary diagnosis, timing of stoma-creation, stoma characteristics (type, location, configuration), surgical technique, and postoperative complications. Stomas were classified by type (jejunostomy, ileostomy, or colostomy), configuration [divergent (completely divided), loop (continuity maintained), or end stoma], and location (based on anatomical segment). Complications were documented and categorized as skin excoriation, prolapse, retraction, stenosis, bleeding, parastomal hernia, ischemia or circulation impairment, and systemic complications (fluid-electrolyte imbalance).

Statistical Analysis

Data were analyzed using IBM SPSS Statistics for Windows, version 25.0 (IBM Corp., Armonk, NY, USA). Descriptive statistics are presented as mean ± standard deviation and median (interquartile range) for continuous variables and as frequencies and percentages

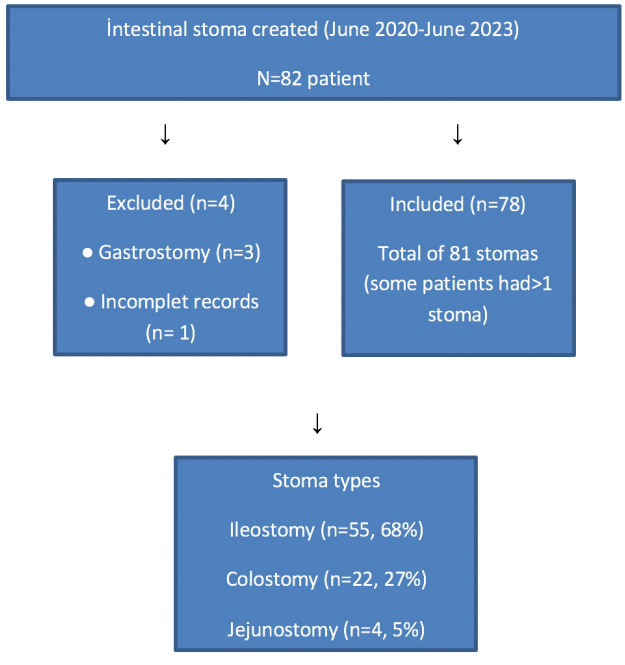

Figure 1. Study flow diagram

for categorical variables. For inferential statistics, the Independent samples t-test was used to compare normally distributed continuous variables between two groups, while the Mann-Whitney U test was applied to non-normally distributed continuous variables. Categorical variables were analyzed using Pearson's chi-square test or Fisher's exact test (when expected cell frequencies were <5). Multiple group comparisons for categorical variables were performed using the chi-square test for independence. Chi-square tests were used to compare complication rates between stoma types. If the sample size was fewer than five, as in jejunostomy, Fisher's exact test was used to assess configuration preferences by indication. A two-tailed p-value <0.05 was considered statistically significant.

Results

Patient Demographics and Stoma Characteristics

During the three-year study period, 81 stomas were performed on 78 patients. Three patients underwent multiple simultaneous stomas: ileostomy and colostomy (n=1), jejunostomy and ileostomy (n=1), and jejunostomy and colostomy (n=1). The gender distribution showed 40 males (51.3%) and 38 females (48.7%), with no significant difference by gender (p=0.832). Age distribution was as follows: neonates (0-28 days), 38 patients (48.7%); infants (1-12 months), 18 patients (23%); children (1-18 years), 22 patients (28.2%). Infants and neonates together represented 71.8% of the cohort (n=56).

Stoma Types and Configurations

Table 1 presents the distribution of stoma types and configurations. A chi-square test was used to analyze stoma types. Ileostomy was the most common (68%, n=55), followed by colostomy (27%, n=22), and jejunostomy (5%, n=4). The distribution of stoma configurations was divergent stomas in 36 cases (44.5%), loop stomas in 34 cases (42%), and end stomas in 11 cases (13.5%). No statistically significant difference was observed between the frequencies of divergent and loop stomas (p=0.742). All stomas were temporary.

Among ileostomies, the divergent configuration was most frequent (49%, n=27), followed by loop (40%, n=22) and end (11%, n=6) configurations. For colostomies, loop configuration predominated (50%, n=11), followed by divergent (36.3%, n=8) and end (13.6%, n=3).

Indications for Stoma-creation

Table 2 details the indications stratified by stoma type. Comparisons of indications were made using the chi-square test. If the sample size was fewer than 5, as

Table 1. Stoma types and configurations

Ostomy types	Jejunostomy (%)	Ileostomy (%)	Colostomy (%)	Total (%)
Divergent	1	27 (49)	8 (36.3)	36 (44.5)
Loop	1	22 (40)	11 (50)	34 (42)
End	2	6 (11)	3 (13.6)	11(13.5)
Total	4 (5)	55 (68)	22 (27)	81 (100)

Chi-square test was used to analyze stoma types. No statistically significant difference was observed between the frequencies of divergent and loop stomas (p=0.742)

Table 2. Indications for stoma creation

Stoma indications (number)	Ileostomy	Colostomy	Jejunostomy	Total
NEC (24)	21	3	1	25
HD (18)	11	7		18
Meconium ileus (9)	9			9
ARM (8)		8		8
Intestinal atresia (5)	4		2	6
Crohn's disease (3)	3	1		4
Trauma (2)		2		2
Volvulus (1)	1			1
Mechanical ileus (6)	5		1	6
FAP (1)	1			1
Latrogenic colon perforation (1)		1		1
Total (78 patient)	55	22	4	81

Chi-square test was used to compare stoma indications. There is a statistically significant difference between the NEC, HD and ARM groups (p<0.05)
NEC: Necrotizing enterocolitis, HD: Hirschsprung disease, ARM: Anorectal malformations, FAP: Familial adenomatous polyposis

in the jejunostomy group, Fisher's exact test was used. Necrotizing enterocolitis was the leading indication (30.7%, n=24), followed by HD (23.1%, n=18), meconium ileus (11.5%, n=9), ARM (10.3%, n=8), intestinal atresia (6.4%, n=5; 4 ileal, 1 jejunal), mechanical ileus (7.7%, n=6), Crohn's disease (3.8%, n=3), trauma (2.6%, n=2), volvulus (1.3%, n=1), familial adenomatous polyposis (1.3%, n=1), and iatrogenic colonic perforation during colonoscopy (1.3%, n=1).

Among NEC patients (n=24), 21 (87.5%) underwent ileostomy (predominantly diverting ileostomies), 3 underwent colostomy, and 1 underwent jejunostomy. Among HD patients (n=18), ileostomy was performed in 11 cases (61%) and colostomy in 7 cases (39%), with loop ileostomy and loop transverse colostomy preferred. All ARM patients (n=8) underwent colostomy: 7 received divergent sigmoid colostomies and 1 received a divergent transverse colostomy.

Complications

Table 3 summarizes stoma-related complications. The overall complication rate was 78.2% (61/78 patients). Skin excoriation was the most common complication (64.1%, n=50), followed by prolapse (6.4%, n=5: 4 in transverse loop colostomy, 1 in loop ileostomy); circulatory impairment (2.6%, n=2: both in severe NEC cases); bleeding (2.6%, n=2: both post-ileostomy for NEC); retraction (1.3%, n=1); and stenosis (1.3%, n=1).

Chi-square tests were used to compare complication rates between stoma types. Complications were more frequent in patients with NEC than in those with other indications (p=0.031). Skin excoriation affected 61.7% of NEC patients. One patient with stoma retraction required surgical revision. Patients with prolapse underwent early stoma closure. Other complications were managed conservatively with medical therapy. No significant differences in complication rates were found between ileostomy and colostomy (p=0.284) or between divergent and loop configurations (p=0.591).

Table 3. Stoma-related complications

Complication	n=patient number
Stenosis	1
Retraction	1
Prolapsus	5
Bleeding	2
Circulation impairment	2
Skin excoriation	50
Total	**61**

Chi-square test was used to compare complication rates between stoma types. While the most common complication was seen in NEC patients (p=0.031, p<0.05), no difference was observed between ileostomy and colostomy (p=0.591)
NEC: Necrotizing enterocolitis

Discussion

This three-year retrospective analysis of 78 pediatric patients undergoing 81 intestinal stomas revealed NEC as the predominant indication (30.7%), contrasting with most published series where ARM typically predominates. This finding validates our hypothesis that institutional infrastructure—specifically, the absence of a dedicated neonatal surgery unit—significantly influences stoma-indication patterns. Our results contribute to understanding how healthcare delivery models shape pediatric surgical practice patterns in different clinical settings.

The predominance of NEC in our series differs from that reported in traditional pediatric stoma literature, where ARM and HD typically constitute the leading indications (6-8,17). A recent multicenter European study by Schaart et al. (18) similarly reported institutional variation in stoma indications, with tertiary neonatal centers demonstrating higher NEC proportions. Our findings align with reports from institutions with high-volume neonatal intensive care units but limited neonatal surgical subspecialization. Conversely, specialized pediatric surgery centers with dedicated ARM programs report higher ARM stoma rates (19,20). Despite the presence of a sufficient number of specialized neonatal surgeons in our institution, adequate neonatal surgery services are lacking.

The relatively low proportion of ARM (10.3%) observed in our cohort likely reflects referral patterns and limited neonatal surgical capacity, as hypothesized. Many ARM patients may have been managed at institutions with specialized neonatal surgery units. This pattern has significant implications for surgical training and resource allocation in general pediatric surgery departments.

Hirschsprung disease was our second most common indication (23.1%), consistent with its established prevalence in pediatric stoma series (21,22). Recent guidelines from the European Society of Pediatric Gastroenterology, Hepatology, and Nutrition (2024) emphasize the continued role of temporary diversion in the management of HD, particularly in cases of total colonic aganglionosis and in critically ill presentations (23).

Meconium ileus (11.5%) constituted a significant proportion of our cases, reflecting the complex management of cystic fibrosis-associated intestinal complications. Contemporary approaches increasingly favor primary anastomosis when possible, reserving stomas for complicated cases with perforation, atresia, or volvulus (24,25).

The predominance of ileostomy (68%) in our series reflects the high proportion of NEC cases, in which ileal involvement is common. This finding is consistent with

recent data from neonatal surgical centers (26,27). The preference for a diverting ileostomy (49% of ileostomies) in NEC cases aligns with current practice patterns that prioritize adequate fecal diversion while minimizing distal limb complications (28).

Debate regarding loop versus divided (divergent) colostomy in ARM management persists in the contemporary literature (29,30). Although we used divergent sigmoid colostomy as our preferred approach for ARM (n=7), recent meta-analyses suggest that loop and divided techniques have comparable outcomes with respect to urinary tract infections and distal fecal impaction, while loop colostomy is associated with shorter operative times (31,32). However, proponents of divided colostomy cite lower prolapse rates and superior fecal diversion (33). Our institutional preference for divided sigmoid colostomy in ARM reflects traditional teaching and surgeons' experience, though prospective comparative studies are needed.

In HD patients, we preferentially performed loop ileostomy and loop transverse colostomy, with stoma location determined by identification of the transition zone. This approach is supported by recent literature emphasizing individualized stoma placement based on intraoperative findings and disease extent (34,35).

Our overall complication rate of 78.2% appears higher than in some reported series but falls within the wide range (21-70%) described in the pediatric stoma literature (1,14-16). The predominance of skin excoriation (64.1%) likely reflects multiple factors, including the young age of patients, liquid stool consistency from proximal stomas, and challenging ostomy care in neonates with fragile skin.

The strong association between NEC and complications ($p=0.031$) has been documented previously, with studies reporting increased rates of retraction, ischemia, and skin problems in this population (3,36).

Prolapse occurred in 6.4% of cases, predominantly in loop colostomies (n=4), consistent with the literature, which reports higher prolapse rates in loop versus divided configurations (37,38). Early stoma closure was our management approach for these cases, avoiding the morbidity associated with surgical revision.

Our low rates of stenosis (1.3%) and retraction (1.3%) compare favorably with published series, potentially reflecting adequate initial stoma construction and meticulous surgical technique (39). The patient requiring revision for retraction underwent a successful reoperation without subsequent complications.

Our findings demonstrate that stoma indication patterns are substantially influenced by institutional characteristics and healthcare delivery models. Centers without dedicated neonatal surgery units may experience different case mixes, emphasizing the importance of maintaining broad pediatric surgical expertise. The high complication rate, particularly skin excoriation, highlights the need for enhanced ostomy care protocols, potentially including early involvement of enterostomal therapy nurses and parental education programs.

Future research should focus on prospective comparison of stoma techniques, development of standardized complication reporting systems, and investigation of quality-of-life outcomes in pediatric ostomy patients. Multicenter collaborative studies would be valuable in establishing best practices adaptable to various institutional settings.

Study Limitations

Several limitations merit consideration in interpreting our findings. First, the retrospective design introduces potential selection and information biases and may involve incomplete documentation of some variables. Second, the absence of standardized protocols for stoma type selection reflects the involvement of multiple surgeons trained in different schools, introducing variability in surgical decision-making. This heterogeneity, while limiting protocol uniformity, may enhance external validity by reflecting real-world practice patterns. Third, our lack of a dedicated neonatal surgery unit limits the generalizability of our findings to specialized centers and likely influenced the distribution of indications. Fourth, the relatively small sample size (n=78) and single-center design limit statistical power for subgroup analyses and reduce broader applicability. Fifth, we lacked long-term follow-up data on the timing of stoma closure, definitive surgical procedures, and ultimate functional outcomes. Finally, we did not systematically assess quality-of-life measures or detailed cost analyses.

Despite these limitations, our study provides valuable real-world data reflecting pediatric stoma practice in a general pediatric surgical setting lacking neonatal subspecialization. Strengths include comprehensive inclusion over three years, detailed documentation of complications, and representation of diverse underlying pathologies. Our findings contribute important insights into how institutional infrastructure shapes pediatric surgical practice patterns; this information is valuable for healthcare planning and surgical training in similar settings. The demonstration of acceptable outcomes despite infrastructure limitations supports the feasibility of managing complex pediatric stoma cases in general pediatric surgery departments with appropriate expertise and resources.

Conclusion

This three-year institutional experience demonstrates that NEC and HD, rather than ARM, predominated as indications for stoma in our setting, reflecting the significant impact of institutional infrastructure, particularly the absence of a dedicated neonatal surgery unit, on pediatric surgical case distribution. Ileostomy was the most frequently performed procedure; divergent and loop configurations were used with similar frequency. While the overall complication rate was high (78.2%), most complications were managed conservatively, and skin excoriation was the most common complication, requiring enhanced ostomy-care protocols.

These findings underscore the importance of recognizing institutional and regional variations in pediatric stoma patterns when planning resources, developing clinical protocols, and designing training programs. Healthcare systems should consider these variations in surgical workforce planning and infrastructure development. Future multicenter prospective studies are needed to establish evidence-based guidelines adaptable to diverse clinical settings and to optimize outcomes for pediatric patients requiring intestinal diversion.

Ethics

Ethics Committee Approval: This retrospective study was approved by the University of Health Sciences Türkiye, Basaksehir Cam and Sakura City Hospital Clinical Research Ethics Committee (approval number: 438, date: 27.09.2023).

Informed Consent: The ethics committee waived the requirement for informed consent because the study was retrospective.

Footnotes

Financial Disclosure: This study received no financial support.

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