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Lessons learned from a retrospective analysis of intestinal atresia management: implications for future practice

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ABSTRACT

Aims: Pediatric intestinal atresia poses a significant challenge for pediatric surgeons, especially in our area, where it is often treated as an emergency. Numerous factors affect patient outcomes, making it essential to identify potential management pitfalls. This study seeks to assess the management and outcomes of neonatal intestinal atresia in our institution, pinpointing challenges, pitfalls, and areas for enhancement to improve patient care and outcomes.

Methods: This is a retrospective observational study conducted at a tertiary care pediatric surgical center in Eastern India. The study spans five years, from January 2020 to June 2025, and includes all neonates and children who underwent surgery for intestinal atresia during this time.

Results: A total of 31 patients with intestinal atresia were included in this retrospective study conducted over five years. Most patients (87%) were in the neonatal age group, with only 13% presenting in the post-neonatal period. There was a male predominance, with 24 males (77.4%) and 7 females (22.6%). Two primary anatomical categories were identified: Jejunoileal atresia (JIA) was the predominant condition, observed in 24 patients (77.4%). Duodenal web or duodenal atresia was present in 7 patients (22.6%). Among the JIA cases, type 3a was the most prevalent, accounting for 22.6%. The average duration to start enteral feeding was 16 days. The mean total duration until discharge was 21.7 days. The overall mortality rate was 38.7%, with 12 out of 31 patients succumbing.

Conclusion: Children with gastrointestinal atresia often present late in their illness, experiencing significant morbidity and mortality due to factors such as poor economic conditions, inadequate nutrition, surgical challenges, and potentially related anomalies, rather than solely surgical morbidity. The high mortality rate observed in our study indicates a need to enhance our management protocols, which may be linked to delayed presentation, insufficient preoperative care, or postoperative complications. Further research is necessary to pinpoint specific areas for improvement and optimise patient outcomes.

Keywords: Infants, newborn, intestinal atresias, duodenal atresia, morbidity

INTRODUCTION

Intestinal atresias are prevalent causes of neonatal bowel obstruction. The incidence is approximately 1 in 6000, aligning with intestinal atresias' range of 1 in 5000 to 10.000 live births, typically manifesting in early life.[1] This condition stems from intrauterine vascular insults causing ischemic necrosis, resorption, and bowel segment discontinuity. Anatomically, atresias range from simple mucosal webs (type I) to complex conditions like apple-peel atresia (type IIIb) and multiple atresias (type IV).[2] Newborns typically present with bilious vomiting, abdominal distention, and failure to pass meconium. Management requires prompt surgical intervention, usually involving resection of the atretic segment with end-to-end anastomosis. In some cases, stoma formation, feeding jejunostomy (FJ), or tapering enteroplasty may be needed, based on intraoperative findings and the child's condition. Intestinal atresia challenges pediatric surgeons, particularly in our region, where it requires emergency treatment. Multiple factors influence outcomes, and identifying management pitfalls is crucial. In this retrospective study, we describe our experience with neonatal intestinal atresia, emphasizing challenges and outcomes at our institution. In our setting—a tertiary care referral hospital in Eastern India—most patients are referred after delayed presentation. Many arrive in poor condition, facing preoperative challenges like dehydration, electrolyte imbalance, sepsis, low birth weight, and poor

nutrition. Associated comorbidities such as prematurity, cardiac anomalies, or abdominal wall defects complicate management. These factors affect surgical approaches, increase complications, prolong time to full enteral feeds, extend hospital stays, and sometimes lead to poor outcomes. We compare our results with international data to identify improvements and optimize care. While literature indicates good overall survival, our outcomes are poorer compared to Western literature, prompting investigation of possible causes.

Objectives

The objectives of this retrospective study are as follows: 1. To describe the demographic and clinical characteristics of neonates with intestinal atresia. 2. To identify potential management pitfalls and their impact on outcomes. 3. To compare our outcomes with international data to inform best practices. By analyzing our experience and comparing it with global standards, we aim to enhance the care and outcomes of neonates with intestinal atresia in our region.

METHODS

The study was conducted with the permission of the All India Institute of Medical Sciences Ethics Committee (Date: 13.05.2025, Decision No: AIIMS/Pat/2025/IEC/1440). All procedures were carried out in accordance with the ethical rules and the principles of the Declaration of Helsinki.

This retrospective observational study was conducted at a tertiary care pediatric surgical centre in Eastern India over five years (January 2020 to January 2025), encompassing all neonates and children undergoing surgery for intestinal atresia. Data were retrieved from electronic medical records and operative registries, encompassing all surgically treated cases within the timeframe. The study aimed to evaluate age at presentation, associated comorbidities, postoperative hospital stay, time to achieve full enteral feeds, whether a stoma was created, and whether a FJ or feeding gastrostomy (FG) was performed, in addition to identifying the type of atresia.

Variables collected included patient age at admission, sex, anatomical diagnosis, type of atresia, associated comorbidities (e.g., malrotation, gastroschisis, cardiac anomalies), intraoperative findings (including bowel discrepancy), and the type of surgical procedure (e.g., resection with anastomosis, stoma formation, FJ/FG placement). Postoperative complications, time to achieve full enteral feeds, duration of postoperative stay, and final outcome (discharged or expired) were recorded. Readmission and postoperative morbidity were also documented when available.

All intestinal atresias were classified based on intraoperative findings. Jejunoileal atresia (JIA) followed the Grosfeld classification: Type I (mucosal web or membrane with intact muscular and serosal wall), type II (blind-ending bowel segments connected by a fibrous cord with intact mesentery), type IIIa (complete separation of bowel ends with a V-shaped mesenteric defect), type IIIb or apple-peel atresia (proximal jejunal atresia with a large mesenteric defect and coiled distal small bowel), and type IV (multiple atresias with a "string-of-sausages" appearance.[2] Duodenal atresia was classified using the Gray and Skandalakis system: Type I (mucosal web with intact muscular wall), type II (atresia with a short fibrous cord and intact mesentery), and type III (complete separation of atretic ends, often with a mesenteric defect.[3] This classification supported prognostic assessment and surgical planning.

Descriptive statistics were used to summarize clinical and operative information. Continuous variables were reported as medians and interquartile ranges (IQR), while categorical variables were presented as absolute numbers and percentages. Comparative analyses were conducted to explore associations between atresia types, comorbidities, and clinical outcomes.

RESULTS

Patient Demographics

This retrospective study, spanning five years, included a total of 31 patients diagnosed with intestinal atresia. Most of these patients (n=27; 87%) were within the neonatal age group, while only 13% (n=4) presented during the post-neonatal period. The median age at presentation for neonates was 6 days, with an interquartile range (IQR) of 4-12 days. There was a notable male predominance, with 24 males (77.4%) and 7 females (22.6%). In the group of newborn cases, 13 cases had a birth weight under 2500 grams. Among these, five were born prematurely (before 37 weeks of gestation), and seven were found to have pneumonia along with sepsis. **Table 1** shows characteristics of patients with atresia. All patients underwent a standard antenatal ultrasound scan, yet prenatal diagnosis was confirmed in just four instances of duodenal atresia. Two primary anatomical categories were identified: JIA, which was the most common, occurring in 24 patients (77.4%), and duodenal web or duodenal atresia, found in 7 patients (22.6%). **Figure 1** illustrates the anatomical distribution of atresia, while **Figure 2** presents intraoperative images of various JIA cases.

Surgical Management

Most patients underwent resection with an end-to-oblique single-layer anastomosis. Stoma formation was performed in only one patient ((3.2%), with Meconium pseudocyst. In 6 patients (19.4%), either a FJ or FG was utilised. Feeding access was more frequently applied in cases of jejunal atresia (4 out of 24 patients) compared to those with duodenal atresia (2 out of 7 patients), indicating the common requirement for staged recovery or postponed oral intake in jejunal conditions. For FJ, a trans-anastomotic 5 French infant feeding tube was used in cases of very proximal jejunal atresia, where the blind pouch was less than 15 centimetres from the duodeno-jejunal junction and the bowel size discrepancy was 5:1 or greater. However, all patients with FJ in JIA developed a bile leak from the FJ site one week after the procedure. Essentially, the FJ site functioned as a controlled fistula (a modification in Santulli enterostomy) that provided low pressure at the anastomosis, promoting healing. Once patients began to tolerate oral feeding, the FJ was clamped, and the infants were discharged with the FJ in situ. The FJ feeding tube was removed at the first follow-up, which occurred two weeks post-discharge.

Table 1. Details of all patients with intestinal atresia

Parameter	Category	Counts	Percentages
Age subclass (n=31)	Neonatal	27	87%
	Post neonatal	4	12.9%
	Median	6	IQR 4-12.0
	IQR	5.5-11	
Sex (n=31)	Male	24	77.4%
	Female	7	22.5%
Weight (kg)	Median	1.8	IQR 1.4-3.0
Comorbidities (n=14, 45.16%)	Malrotation	4	12.90%
	CHD	4	12.90%
	RDS	1	3.22%
	Internal herniation+ CHD	2	6.45%
	Right inguinal hernia	1	3.22%
	Anorectal malformation	2	6.45%
Time to discharge (n=21)	11–20 days	8	50%
	1–10 days	7	16.6%
	21–30 days	4	8.3%
	>30 days	2	25%
	Median	18.5	IQR-9-27.5

IQR: Interquartile range, CHD: Congenital heart disease (ventricular septal defect), RDS: Respiratory distress syndrome

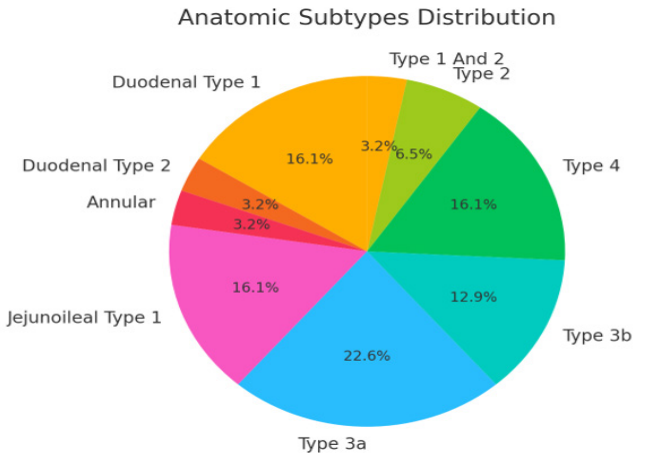

Figure 1. Anatomical distribution of atresia

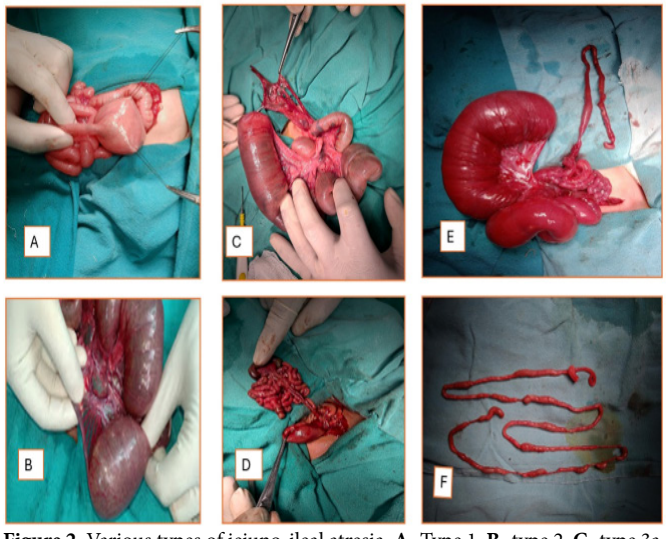

Figure 2. Various types of jejuno-ileal atresia. **A**- Type 1, **B**- type 2, **C**- type 3a, **D**- type 3b (apple peel or Christmas tree, **E**- type 4, **F**- excised large segment of small bowel in type 4 (multiple atresia)

Both the patients and their attendants were comfortable with this fistula, and the attendants were instructed on fistula care. This fistula was managed conservatively and typically healed on its own once distal bowel peristalsis was established, which could take up to 3-4 months post-surgery. All these patients achieved 100% survival.

Intraoperative Findings

- Bowel discrepancy-the most frequent ratio was ≥5:1 (n=23; 74.2%), followed by ≤5:1 (n=8; 25.80%)
- Meconium pseudocyst and dense adhesion were seen in 6.45% (n=2)
- Devitalized bowel due to volvulus of a segment of bowel was also seen in 6.45% (n=2).

Postoperative Outcomes

The mortality rate was 38.7%, with 12 out of 31 patients passing away, while 19 patients, accounting for 61.3%, were discharged. **Table 2** provides details of all the patients who expired.

Table 2. Details of expired patients

No of expired patients (n=12)	Details of patients
4	Preoperative sepsis
2	Devitalised bowel (1), type 4 atresia (1)
2	Delayed presentation (≥10 days of life)+anastomotic leak
2	Premature with low birth weight (<1500grams)+CHD
2	Post discharge*

*Both patients were confirmed to have expired after discharge through telephonic communication. These individuals exhibited prolonged ileus and failure to thrive. All these cases weighed less than 2500 grams with lumen disparity ≥5:1. CHD: Congenital heart disease

The median time to full enteral feeds was 16 (IQR- 8.5-22.0) days. Total parenteral nutrition (TPN) was not available for any patient. Postoperative feeding was done by partial parenteral nutrition using dextrose in Ringer's lactate, parenteral amino acids, and multivitamins. The typical duration of a hospital stay after surgery was 21.7 days on average, with a median of 18.5 days, indicating that some patients experienced extended recovery periods as inpatients (**Table 1**).

Postoperative Complications

- Postoperative complications occurred in 20 patients (64.51%).
- Adynamic ileus was the most commonly seen in 12 patients (60%) all in JIA patients with lumen disparity ≥5:1.
  - » Pneumonia (mostly due to aspiration and prolonged immobility) was seen in 7 patients (35% of complications)
  - » Reoperation was done in 5 (3 anastomotic leaks+2 adhesive obstructions) patients (16.12% of complications)
  - » Anastomotic leak was seen in 3 patients (15% of complications).
  - » Neonatal jaundice: 5 patients (25% of complications)

» Surgical wound infection occurred in 1 patient (05%) (**Table 3, 4**).

Table 3. Postoperative complications

Serial No.	Postoperative complications
1.	Adynamic ileus (n=12)
2.	Pneumonia (n=7)
3.	Neonatal sepsis and jaundice (n=5)
4.	Reoperation (n=5)
5.	Anastomotic leak (n=3)
6.	Surgical wound infection (n=1)

Table 4. Summary of results

Parameter	Summary
Age subclass	Median age 6 days (IQR 4–12)
Sex	Male predominance (M: F≈3:1)
Weight	Majority low birth weight (IQR 1.4-2)
Anatomic classification	Majority had jejunoileal atresia
Outcome	Mortality rate: 38.7%
Discrepancy category	Most had lumen discrepancy ≥5:1
Complications	Adynamic ileus and pneumonia most common
Stoma	Rare (only 1 case)
Feeding jejunostomy/gastrostomy	Used in 19.4% of cases
Length of hospital stay	Median time to discharge: 18.5 days

DISCUSSION

Intestinal atresia is a birth defect where a section of the intestine fails to develop completely, leading to significant bowel obstruction in infants. The survival rates and long-term prognosis are heavily influenced by the type and location of the atresia, as well as any related abnormalities. Although improvements in neonatal care have enhanced survival rates over the past few decades, there are still notable disparities, especially in developing nations.

Our research underscores the difficulties encountered in treating intestinal atresia in environments with limited resources. The patient demographics reveal a predominance of males (77.4%) and a majority of neonates (87%). Intestinal atresias frequently lead to bowel obstruction in newborns, and in our study, the majority of patients were diagnosed during the neonatal period.

The gender distribution in our study contrasts with international findings. While many studies indicate a nearly equal occurrence between genders, our research identified a male predominance.[1,4,5] This variation might be due to factors such as population-specific characteristics, genetic influences, or differences in study methodologies.

In our area, it is quite common for surgical neonates to experience delayed presentation and high mortality rates. This study found that the median age of neonates was 6 days, with an interquartile range of 4 to 12 days. A similar study from India and Pakistan indicated that approximately 78% of neonates with intestinal atresias presented after 48 hours.[1,6] Researchers in Nigeria and Ethiopia have reported similar findings, with 63.2% and 72% of cases, respectively, exhibiting delayed presentation.[7,8]

In our context, several factors contribute to the delay in referring patients from peripheral centers. These include inadequate neonatal care, which leads to delayed diagnosis, and some families' reluctance to disclose the disease to others. A significant observation in our group was the notable percentage (13%) of post-neonatal cases and the considerable number of patients arriving with inadequate nutritional reserves and related comorbidities. Additionally, the absence of prenatal detection has further contributed to delayed presentation. This delay increases the risk of complications, including sepsis and respiratory compromise. This is in contrast to centers with early antenatal diagnosis and referral pathways where timely surgical correction leads to improved outcomes.[9,10]

In our study, JIA emerged as the most prevalent condition, accounting for 77.4% of cases, with type 3a and type 4 being the most frequently observed subtypes. This aligns with international findings where type 3a is commonly seen.[11-13] The anatomical classification followed Grosfeld's modification for JIA and Gray & Skandalakis' for duodenal atresia, allowing standardization of operative planning.

In our study, a significant bowel lumen discrepancy (greater than 5:1) was observed in the majority (74.2%) of cases, likely due to delayed presentation. This delay leads to prolonged stagnation of bowel contents, followed by intense peristaltic activity, ultimately resulting in the affected segment becoming more dilated, hypertrophic, and lacking peristalsis.

In our review of the literature, we did not identify any classification system that specifically addresses the difference between the proximal and distal bowel segments in cases of intestinal atresia. While some studies referred to a "gross discrepancy," they did not specify dimensional criteria. Interestingly, in many instances where there was a significant difference in bowel diameter, other researchers chose to create a stoma.[12,14] However, in our series, we avoided forming a stoma even when the bowel diameter discrepancy was greater than 5:1, as this could result in high stoma output and malabsorption, which we are not well-prepared to handle due to the limited availability of TPN. Instead, we performed oblique anastomosis in all such cases and, in some situations, inserted a trans-anastomotic FJ, which might be a novel technique. The site of the FJ developed into a controlled fistula, which not only decompressed the dilated bowel but also reduced pressure at the anastomotic site, thereby aiding in healing.

In our study, 45.16% of intestinal atresia cases were found to have associated anomalies. This aligns with other research, which indicates that such anomalies occur in 30-75% of cases, with duodenal atresias more frequently exhibiting these associated anomalies.[1,6,15]

In the majority of cases, primary anastomosis was carried out. Stomas were avoided except in one patient who had a meconium pseudocyst and dense adhesions, due to the

risk of complications like fluid and electrolyte imbalance, stoma prolapse, and delays in restoring bowel continuity. Techniques such as tapering enteroplasty and managing luminal discrepancies were used selectively. Our findings indicate varying discrepancy ratios, with most exceeding a 5:1 ratio, which allowed for safe anastomosis without significant complications. Importantly, six patients needed FJ or gastrostomy because of severe proximal dilation or related motility problems, aligning with literature that supports feeding access in complex situations.[16-18]

The high complication rate of 64.5% observed in our study can be attributed to delayed presentation, suboptimal neonatal intensive care, and limited resources. Patients presenting with additional anomalies and low birth weight, who require further treatment, are more susceptible to complications. This situation results in unacceptably high morbidity, extended hospital stays, and increased medical costs. A similar study reported a lower complication rate among their patients.[7,19,20]

Our research determined that the median duration to achieve full enteral nutrition was 16 days. In instances of JIA, this duration was significantly extended compared to duodenal atresia, with median durations of 19 and 8 days, respectively. Several established factors can affect the time required to attain full enteral intake and, consequently, the length of hospital stay. These factors include sepsis, significant luminal discrepancy, prolonged adynamic ileus, and the necessity for additional surgical interventions. These findings are consistent with those reported in other studies. Previous research has suggested that the time to full enteral feeding is also influenced by the type of JIA (jejunal or ileal), the remaining bowel length, the presence of short bowel syndrome, and other concurrent congenital anomalies.[20,22]

Our overall mortality was 38.7%, which is significantly higher than reported in developed healthcare systems. The causes of mortality were multifactorial, including sepsis, respiratory distress, and severe comorbidities such as congenital heart disease. Despite these challenges, 19 patients (61.3%) were successfully discharged.

Mortality rates for JIA are significantly lower in high-income countries, with survival rates approaching over 90%, compared to low- and middle-income countries, where survival rates remain considerably lower, ranging from 58% to 71.5%.[4,23,24]

The advancements in managing atresia, such as the adoption of laparoscopy, bowel lengthening methods (serial transverse enteroplasty (STEP), Bianchi procedure (longitudinal intestinal lengthening and tailoring-LILT), and spiral intestinal lengthening and tailoring (SILT)), and innovative anastomotic techniques, underscore the improvements in surgical treatment. Nonetheless, in resource-limited environments like ours, the focus should remain on early detection, prompt referral, and precise intraoperative procedures.[25,26]

Limitations

Our study, being retrospective, is subject to certain limitations, including the presence of missing data for deceased patients and the absence of long-term follow-up. Nevertheless, it represents one of the most extensive recent series from Eastern India, highlighting the urgent need for enhancing perinatal detection and neonatal care pathways.

Upon analysing the results, we identify several factors contributing to the elevated mortality rates.

- Insufficient prenatal screening for congenital anomalies results in delays in diagnosis and referral, causing most patients to arrive at the emergency department already suffering from sepsis and pneumonia.
- The lack of pediatric surgical care facilities in remote areas led to delayed treatment and adverse outcomes.
- The absence of TPN in our institution restricted our capacity to deliver optimal postoperative care, thereby contributing to poor outcomes.
- Patients exhibited a negative nitrogen balance due to delayed diagnosis and treatment, adversely affecting postoperative outcomes.
- In instances of significantly dilated and hypertrophic pouches, resection was unfeasible due to the risk of short bowel syndrome, resulting in complications and mortality.
- Cases involving type 4 atresia necessitating resection of extensive bowel segments experienced high mortality rates due to short bowel syndrome and the inability to provide adequate nutrition.

CONCLUSION

To sum up, our research emphasises the difficulties and intricacies involved in treating intestinal atresia in environments with limited resources. Despite these obstacles, we have gained important insights that can lead to improved care and outcomes for these at-risk patients. Our results highlight the necessity for better perinatal detection, timely referrals, and accurate surgical procedures to boost the survival rates and quality of life for newborns with intestinal atresia. We aspire that our experiences will aid in the ongoing initiatives to enhance pediatric surgical care in our area and beyond, ultimately offering hope and healing to the families and children impacted by this condition.

ETHICAL DECLARATIONS

Ethics Committee Approval

The study was conducted with the permission of the All India Institute of Medical Sciences Ethics Committee (Date: 13.05.2025, Decision No: AIIMS/Pat/2025/IEC/1440).

Informed Consent

Because the study was designed retrospectively, no written informed consent form was obtained from patients.

Referee Evaluation Process

Externally peer-reviewed.

Conflict of Interest Statement

The authors have no conflicts of interest to declare.

Financial Disclosure

The authors declared that this study has received no financial support.

Author Contributions

All of the authors declare that they have all participated in the design, execution, and analysis of the paper, and that they have approved the final version.

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