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Management and Outcomes of Neonatal Intestinal Atresia: A 12-Year Experience of a Tertiary Care Center

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Abstract: ***Background**: Neonatal intestinal atresia is an important cause of intestinal obstruction in newborns and usually requires early surgical treatment. Outcome depends on early diagnosis, timely referral, surgical care, and postoperative neonatal support. **Aim**: To evaluate the management and outcomes of neonatal intestinal atresia over a 12-year period at a tertiary care center. **Methods**: This retrospective observational hospital-based study was conducted in the Department of Surgery, B.R.D. Medical College, Gorakhpur, from 2014 to 2025. A total of 120 neonates diagnosed with intestinal atresia and managed surgically were included. Demographic details, clinical presentation, diagnostic findings, operative procedures, postoperative complications, hospital stay, and outcome were analyzed. **Results**: Among 120 neonates, 69 (57.5%) were males and 90 (75.0%) were preterm. Antenatal diagnosis was made in 24 cases (20.0%). Bilious vomiting was the commonest symptom, seen in 57 cases (47.5%). Most neonates underwent surgery between 8 and 28 days of life. Kimura/duodenoduodenostomy was the most common procedure, performed in 42 cases (35.0%). Postoperative sepsis was documented in 12 cases (10.0%). Overall survival was 45.0%. Prematurity was significantly associated with mortality ($p < 0.001$), and NICU stay was significantly longer among non-survivors ($p = 0.004$). **Conclusion**: Neonatal intestinal atresia remains a serious surgical condition with high mortality. Early diagnosis, timely referral, proper stabilization, infection control, and better neonatal intensive care may help improve survival.*

Keywords: Intestinal Atresia; Infant, Newborn; Neonatal Surgery; Postoperative Complications; Treatment Outcome.

1. Introduction

Neonatal intestinal atresia is a congenital condition in which there is complete blockage of the intestinal lumen. It is an important cause of intestinal obstruction in newborns and usually needs early surgical treatment. The obstruction may be present in the duodenum, jejunum, ileum, or colon. The clinical features, associated anomalies, operative procedure, and outcome may vary according to the site of atresia.[1–3]

The cause of intestinal atresia depends on the part of bowel involved. Duodenal atresia is mainly related to failure of recanalization during early development. Jejunal and ileal atresias are commonly related to an intrauterine vascular accident, which leads to loss of a part of the developing intestine.[4,5] These changes may cause dilatation of the bowel before the obstruction and poor development of the bowel beyond it. This can affect the type of surgery, return of bowel function, feeding, and recovery after surgery.[6]

The common clinical features of neonatal intestinal atresia include bilious vomiting, abdominal distension, feeding intolerance, and failure to pass meconium. Bilious vomiting in a newborn is an important warning sign and should be evaluated urgently, as delay in diagnosis can lead to dehydration, electrolyte imbalance, sepsis, and death.[7-9] Antenatal ultrasonography may suggest the diagnosis in some cases, especially when polyhydramnios, dilated bowel loops, or a double bubble sign is seen. However, many cases are diagnosed only after birth by clinical examination and radiological evaluation.[10,11]

The management of neonatal intestinal atresia starts with proper stabilization of the newborn. This includes nasogastric decompression, correction of fluid and electrolyte imbalance, prevention of hypothermia, and use of antibiotics when required. Definitive treatment is surgical, and the procedure depends on the site of atresia, condition of the bowel, associated anomalies, and general condition of the neonate.[12,13] Even after surgery, complications such as sepsis, anastomotic leak, prolonged ileus, respiratory problems, and feeding difficulty may occur and can affect survival.[14-16]

Outcomes of neonatal intestinal atresia have improved with better surgery, anesthesia, neonatal care, and nutritional support. Still, mortality and morbidity remain high in many centers, especially when neonates present late or have prematurity, low birth weight, sepsis, or associated anomalies.[17-20] Indian studies have shown that intestinal atresia remains an important part of neonatal surgical work, and results may differ between centers due to differences in referral pattern, availability of neonatal intensive care, and postoperative support.[21,22]

Therefore, long-term data from individual centers are important to understand the pattern of presentation, diagnosis, surgical management, complications, and outcome of these neonates. The present study was conducted to evaluate the management and outcomes of neonatal intestinal atresia over a 12-year period at a tertiary care center and to identify factors affecting morbidity and survival.

2. Material and Methods

Study Design
This was a retrospective observational hospital-based study.

Study Setting
The study was conducted in the Department of Surgery, B.R.D. Medical College, Gorakhpur, Uttar Pradesh, India.

Study Duration
The study was conducted over a period of 12 years, from 2014 to 2025.

Study Population
Neonates diagnosed with intestinal atresia and admitted to the Department of Surgery, B.R.D. Medical College, Gorakhpur, during the study period were included.

Sample Size
All eligible neonates with intestinal atresia admitted during the study period were included. A total of 120 neonates were included in the study.

Study Groups
The neonates were grouped according to the type of intestinal atresia:
- Duodenal atresia
- Jejunal atresia
- Ileal atresia
- Colonic atresia
- Rectal atresia
- Anal atresia

For outcome analysis, patients were also grouped according to survival status:
- Survivors
- Non-survivors

Inclusion Criteria
- Neonates diagnosed with intestinal atresia, including duodenal, jejunoileal, or colonic atresia
- Diagnosis based on clinical and radiological findings
- Cases with complete medical records available for analysis
- Cases with written informed consent available

Exclusion Criteria
- Neonates with other causes of intestinal obstruction, such as meconium ileus and Hirschsprung's disease
- Cases with incomplete medical records
- Neonates who did not undergo surgical management

3. Methodology

Data were collected retrospectively from the hospital records of all eligible neonates. The details recorded included age, sex, gestational age, birth weight, mode of delivery, maternal history, clinical presentation, diagnostic findings, operative details, postoperative course, complications, and outcome.

Clinical presentation was noted in the form of bilious vomiting, abdominal distension, feeding intolerance, failure to pass meconium, and age at presentation. Antenatal ultrasonography findings, postnatal radiographic findings, and laboratory investigations were recorded.

Operative records were reviewed to note the type of intestinal atresia, surgical procedure performed, and intraoperative findings. Postoperative details included requirement of total parenteral nutrition, duration of NICU stay, total hospital stay, and complications such as sepsis, anastomotic leak, prolonged ileus, respiratory complications, and short bowel syndrome. Final outcome was assessed in terms of survival, mortality, morbidity, and available follow-up data.

4. Statistical Analysis

Data were entered in Microsoft Excel and analyzed using SPSS version 24.0. Continuous variables were expressed as mean ± standard deviation or median with interquartile range, as appropriate. Categorical variables were expressed as frequency and percentage. Categorical variables were compared using the Chi-square test or Fisher's exact test. Continuous variables were compared using Student's t-test or Mann–Whitney U test, as appropriate. Survival analysis was done using the Kaplan–Meier method. A p-value <0.05 was considered statistically significant.

5. Ethical Considerations

The study was conducted after approval from the Institutional Ethics Committee. Written informed consent was available for the included cases. Patient confidentiality was maintained throughout the study.

6. Results

A total of 120 neonates with intestinal atresia were included in the study.

As shown in **Table 1**, males were more common than females. There were 69 males (57.5%) and 51 females (42.5%). Most neonates were preterm, accounting for 90 cases (75.0%), while 30 neonates (25.0%) were term. The mean gestational age was 34.6 ± 2.57 weeks. Low birth weight was present in 60 neonates (50.0%), and the remaining 60 neonates (50.0%) had normal birth weight. The mean birth weight was 2486 ± 525 g. Vaginal delivery was more common and was seen in 81 cases (67.5%), while 39 neonates (32.5%) were delivered by cesarean section.

As shown in **Table 2**, antenatal diagnosis was made in only 24 neonates (20.0%), whereas 96 neonates (80.0%) were not diagnosed before birth. Among antenatal ultrasonographic findings, polyhydramnios was the most common finding, seen in 24 cases (66.7%), followed by dilated bowel loops in 9 cases (25.0%) and double bubble sign in 3 cases (8.3%). Maternal history was normal in most cases, with no significant history in 114 mothers (95.0%). Hypertension and hypothyroidism were present in 3 cases each (2.5% each).

Clinical presentation at admission is also shown in **Table 2**. The mean age at presentation was 13.8 ± 39.1 days. Most neonates presented early, with 54 cases (45.0%) presenting within 0–2 days of life and 33 cases (27.5%) presenting between 3–7 days. Twenty-four neonates (20.0%) presented

between 8–28 days, while 9 neonates (7.5%) presented after 28 days. The most common presenting symptom was bilious vomiting, seen in 57 neonates (47.5%). Feeding intolerance was present in 39 cases (32.5%), abdominal distension in 33 cases (27.5%), and failure to pass meconium in 9 cases (7.5%).

As shown in **Figure 1**, postnatal radiographic findings varied according to the type of intestinal atresia. Air-fluid levels were the most common finding overall and were seen in all cases of anal atresia, colonic atresia, ileal atresia, and rectal atresia. In duodenal atresia, double bubble sign was the main finding and was seen in 33 cases, while air-fluid levels were seen in 12 cases. In jejunal atresia, air-fluid levels were seen in 9 cases, while double bubble sign and gas under diaphragm were seen in 3 cases each. Gas under diaphragm was uncommon and was seen only in jejunal atresia.

As shown in **Table 3**, most neonates underwent surgery between 8 and 28 days of life, accounting for 69 cases (57.5%). Surgery was done within 0–2 days in 3 cases (2.5%), between 3–7 days in 27 cases (22.5%), and after 28 days in 21 cases (17.5%). The most common operative procedure was Kimura/duodenoduodenostomy, performed in 42 cases (35.0%). Stoma or diversion procedure was done in 24 cases (20.0%), resection with anastomosis in 21 cases (17.5%), resection with stoma in 15 cases (12.5%), resection with anastomosis and stoma in 12 cases (10.0%), and other procedures in 6 cases (5.0%).

As shown in **Figure 2**, the operative procedure was selected according to the type of atresia. Kimura/ duodenoduodenostomy was mainly performed for duodenal atresia, with 39 cases. Jejunal atresia was mostly treated by resection with anastomosis, seen in 12 cases. Colonic atresia was most commonly treated by stoma or diversion procedure in 15 cases, followed by resection with stoma in 9 cases and resection with anastomosis with stoma in 6 cases. Ileal atresia required different procedures, including resection with stoma, resection with anastomosis, and resection with anastomosis with stoma, each seen in 6 cases. Anal and rectal atresia were mainly managed by diversion procedures.

As shown in **Table 4**, postoperative complications were documented in 12 neonates (10.0%), and all these cases had sepsis. No documented postoperative complication was present in 108 neonates (90.0%). Sepsis was seen in 3 cases each after Kimura/duodenoduodenostomy, stoma/diversion procedure, resection with stoma, and resection with anastomosis. No sepsis was documented after resection with anastomosis and stoma or after other procedures.

As shown in **Figure 3**, the mean NICU stay was 11.78 ± 10.36 days, while the mean total hospital stay was 19.13 ± 8.78 days. This shows that neonates with intestinal atresia required a considerable period of intensive care and hospital care after surgery. The variation in stay was wide, suggesting differences in clinical condition, recovery, and postoperative complications among patients.

As shown in **Table 5**, 54 neonates survived at discharge, giving an overall survival rate of 45.0%. Sixty-six neonates (55.0%) expired. Readmission was uncommon and was required in only 3 cases (2.5%), while 117 cases (97.5%) did not require readmission. Long-term follow-up was not documented in most cases, with 93 cases (77.5%) having no follow-up data. Among the documented follow-up cases, normal growth and development were seen in 15 cases (12.5%), nutritional deficiency in 6 cases (5.0%), normal growth with colostomy closure at 1 year in 3 cases (2.5%), and death during follow-up in 3 cases (2.5%).

As shown in **Table 6**, gestational category showed a significant association with survival. Among preterm neonates, 30 cases (33.3%) survived and 60 cases (66.7%) expired. Among term neonates, 24 cases (80.0%) survived and 6 cases (20.0%) expired. This association was statistically significant ($p < 0.001$). Birth weight category did not show a significant association with survival. Among low-birth-weight neonates, 24 cases (40.0%) survived and 36 cases (60.0%) expired, while among normal birth weight neonates, 30 cases (50.0%) survived and 30 cases (50.0%) expired ($p = 0.359$).

Antenatal diagnosis was also not significantly associated with survival. Among neonates without antenatal diagnosis, 42 cases (43.8%) survived and 54 cases (56.2%) expired. Among antenatally diagnosed cases, 12 cases (50.0%) survived and 12 cases (50.0%) expired ($p = 0.748$). Associated anomalies were present in 6 cases, out of which 1 case (16.7%) survived and 5 cases (83.3%) expired, but this was not statistically significant ($p = 0.221$).

Electrolyte imbalance was documented in 6 neonates, of which 2 cases (33.3%) survived and 4 cases (66.7%) expired. Among neonates without electrolyte imbalance, 33 cases (52.4%) survived and 30 cases (47.6%) expired. This association was not statistically significant ($p = 0.228$).

Survival also varied according to the operative procedure, but the difference was not statistically significant ($p = 0.081$). Survival was higher in neonates who underwent resection with anastomosis and stoma, with 9 survivors out of 12 cases (75.0%). Mortality was higher in neonates who underwent Kimura/duodenoduodenostomy and resection with anastomosis, where 66.7% expired in each group.

Postoperative sepsis showed a higher mortality trend. Among neonates with no documented postoperative complication, 52 cases (48.1%) survived and 56 cases (51.9%) expired. Among neonates with sepsis, only 2 cases (16.7%) survived, while 10 cases (83.3%) expired. However, this association did not reach statistical significance ($p = 0.063$).

As shown in **Table 7**, most continuous variables did not show a significant difference between survivors and non-survivors. The mean age at presentation was 15.8 ± 32.4 days among survivors and 12.1 ± 43.8 days among expired neonates ($p = 0.412$). Hemoglobin, WBC count, and CRP were also not significantly different between the two groups. The mean hemoglobin was 9.72 ± 1.84 g/dL among survivors and 9.31 ± 3.22 g/dL among expired neonates ($p = 0.436$). The mean WBC count was 9220 ± 2810/µL among survivors and 10240 ± 5119/µL among expired neonates ($p = 0.524$). The mean CRP was 38.7 ± 14.2 mg/L among survivors and 44.6 ± 24.8 mg/L among expired neonates ($p = 0.711$).

NICU stay showed a significant difference between survivors and non-survivors. The mean NICU stay was 8.64 ± 8.11 days among survivors and 14.35 ± 11.11 days among expired neonates. This difference was statistically significant (p = 0.004). Total hospital stay was not significantly different between the two groups. The mean hospital stay was 20.11 ± 8.26 days among survivors and 18.28 ± 8.97 days among expired neonates (p = 0.248).

Overall, the main findings of this study were that most neonates were preterm, antenatal diagnosis was low, bilious vomiting was the commonest presenting symptom, Kimura/duodenoduodenostomy was the most common surgical procedure, postoperative sepsis was the only documented complication, and overall survival was 45.0%. Prematurity and longer NICU stay were significantly associated with poor outcome.

7. Discussion

The present study included 120 neonates with intestinal atresia who were treated over a period of 12 years. The study assessed their clinical profile, antenatal diagnosis, operative management, postoperative complications, hospital stay, and survival outcome.

In **Table 1**, males were more common than females, with 69 males (57.5%) and 51 females (42.5%). Most neonates were preterm, forming 90 cases (75.0%), while 30 neonates (25.0%) were term. The mean gestational age was 34.6 ± 2.57 weeks. Low birth weight was present in 60 neonates (50.0%), and the mean birth weight was 2486 ± 525 g. This shows that prematurity and low birth weight were common in the present study. Gupta et al.[21] reported a similar pattern in neonates with intestinal atresia and observed that prematurity and low birth weight increased postoperative risk. Singh et al.[22] also found that low birth weight and prematurity were frequent in congenital neonatal intestinal obstruction and were related to higher morbidity and mortality.

In **Table 2**, antenatal diagnosis was made in only 24 neonates (20.0%), while 96 neonates (80.0%) were diagnosed after birth. Among antenatal ultrasound findings, polyhydramnios was the most common finding, seen in 24 cases (66.7%), followed by dilated bowel loops in 9 cases (25.0%) and double bubble sign in 3 cases (8.3%). This shows that antenatal detection was low, although abnormal ultrasound findings were present in some cases. Hao et al.[10] reported that polyhydramnios and dilated bowel loops are useful antenatal signs of small bowel atresia, but they may not always give a definite diagnosis. Bishop et al.[11] found that double bubble sign is an important antenatal marker of duodenal obstruction and helps in early planning of care.

Clinical presentation was also included. Most neonates presented early, with 54 cases (45.0%) presenting within the first 2 days and 33 cases (27.5%) between 3 and 7 days. The mean age at presentation was 13.8 ± 39.1 days, showing wide variation in referral and diagnosis. Bilious vomiting was the most common symptom, seen in 57 neonates (47.5%), followed by feeding intolerance in 39 cases (32.5%), abdominal distension in 33 cases (27.5%), and failure to pass meconium in 9 cases (7.5%). Verma et al.[20] also reported bilious vomiting and abdominal distension as common presenting features in neonatal intestinal obstruction. Sevar et al.[23] observed that many neonates present early, but delayed referral is still common in developing settings and can affect outcome.

Figure 1 showed that postnatal radiographic findings were related to the anatomical level of obstruction. Air-fluid levels were common in distal atresias, while double bubble sign was mainly seen in duodenal atresia. This supports the role of plain radiography in early diagnosis and operative planning. Baad et al.[24] reported that radiological evaluation is useful in defining the level of obstruction in neonates with suspected intestinal obstruction. Rich et al.[3] also described double bubble sign as a characteristic finding of duodenal atresia and an important clue for early diagnosis.

In **Table 3**, most neonates underwent surgery between 8 and 28 days of life, accounting for 69 cases (57.5%). Only 3 neonates (2.5%) underwent surgery within 0–2 days. This suggests delay in surgical intervention in many cases, likely due to delayed presentation, referral, stabilization, or associated clinical condition. The most common operation was Kimura/duodenoduodenostomy, done in 42 cases (35.0%). Stoma or diversion procedure was done in 24 cases (20.0%), resection with anastomosis in 21 cases (17.5%), resection with stoma in 15 cases (12.5%), and resection with anastomosis with stoma in 12 cases (10.0%). Fung et al.[25] reported that primary anastomosis or primary repair gives good results in selected neonates when the general condition and bowel condition are suitable. Sevar et al.[23] also stated that the choice of operation depends on the site of atresia, bowel condition, and condition of the newborn.

Figure 2 further showed that the operative procedure changed according to the type of atresia. Duodenal atresia was mainly treated by Kimura/duodenoduodenostomy, while jejunal and ileal atresias were commonly treated by resection-based procedures. Colonic, anal, and rectal atresias often required diversion procedures. This is expected because proximal and distal atresias need different surgical approaches. Gupta et al.[21] also reported that operative treatment varies with the level of obstruction and intraoperative findings. Singh et al.[22] similarly observed that procedure selection in neonatal intestinal obstruction depends on the type and site of lesion.

In **Table 4**, postoperative complications were documented in 12 neonates (10.0%), and all these cases had sepsis. No documented complication was present in 108 neonates (90.0%). Sepsis was seen after different procedures and was not limited to one operative group. It occurred in 3 cases each after Kimura/duodenoduodenostomy, stoma/diversion, resection with stoma, and resection with anastomosis. Michelet et al.[14] reported that sepsis is one of the important postoperative complications in neonates and infants after surgery. Koenig et al.[13] also found that postoperative sepsis remains a major factor responsible for poor outcome in intestinal atresia, even with better surgical care.

Figure 3 showed the duration of NICU stay and total hospital stay. The mean NICU stay was 11.78 ± 10.36 days, while the mean hospital stay was 19.13 ± 8.78 days. This reflects the need for prolonged postoperative care in many neonates. In

Table 7, NICU stay was significantly longer in non-survivors than survivors. Non-survivors had a mean NICU stay of 14.35 ± 11.11 days, while survivors had 8.64 ± 8.11 days, and this difference was statistically significant ($p = 0.004$). Koenig et al.[13] reported that longer hospital and intensive care stay is usually seen in neonates with complications and severe illness. Sevar et al.[23] also observed that prolonged intensive care requirement is related to postoperative complications and poor recovery.

In **Table 5**, 54 neonates survived at discharge, giving a survival rate of 45.0%, while 66 neonates (55.0%) expired. Readmission was uncommon and was needed in only 3 cases (2.5%). Long-term follow-up was not documented in 93 cases (77.5%), which limits the assessment of long-term growth and nutrition. Among documented cases, 15 neonates had normal growth and development, 6 had nutritional deficiency, and 3 had normal growth with colostomy closure at 1 year. Gupta et al.[21] reported better survival than the present study, but also found sepsis and low birth weight to be important causes of poor outcome. Wright et al.[19] showed that mortality in congenital gastrointestinal anomalies is much higher in centers with limited neonatal surgical and intensive care support, which may explain the lower survival in resource-limited settings.

In **Table 6**, gestational age was the strongest factor associated with survival. Among preterm neonates, 60 out of 90 (66.7%) expired, while among term neonates, only 6 out of 30 (20.0%) expired. This association was statistically significant ($p < 0.001$). Birth weight, antenatal diagnosis, associated anomalies, electrolyte imbalance, procedure group, and postoperative complications did not show statistically significant association with survival. However, mortality was higher among neonates with postoperative sepsis, where 10 out of 12 cases (83.3%) expired. Puri et al.[18] reported prematurity as an important predictor of mortality in neonatal surgical patients, along with sepsis and low birth weight. Tahkola et al.[26] also found that prematurity, low birth weight, associated anomalies, and sepsis continue to affect survival, although outcomes have improved over time.
In **Table 7**, other continuous variables such as age at presentation, hemoglobin, WBC count, CRP, and total hospital stay did not show significant differences between survivors and non-survivors. Only NICU stay showed a significant difference. This means that baseline laboratory values alone were not strong predictors of survival in this study. The clinical course after surgery and the need for intensive care appeared more important. Michelet et al.[14] also reported that postoperative complications and intensive care needs are important in determining outcome after neonatal surgery. Koenig et al.[13] similarly emphasized that outcome depends not only on the operation but also on postoperative condition, infection control, nutrition, and intensive care support.

8. Conclusion

Neonatal intestinal atresia is a serious surgical condition that needs early diagnosis, timely referral, and proper perioperative care. The outcome depends on the condition of the newborn at presentation, availability of neonatal intensive care, control of sepsis, nutritional support, and careful postoperative monitoring. A planned approach involving antenatal suspicion, early stabilization, appropriate surgery, and regular follow-up can help improve survival and reduce long-term complications. Strengthening neonatal surgical care and follow-up services is essential for better recovery, growth, and overall outcome in these neonates.

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Tables

Table 1: Baseline demographic and perinatal profile of neonates with intestinal atresia (n = 120)

Variable	Category / Statistic	Frequency	Percentage
Gender	Male	69	57.5%
	Female	51	42.5%
Gestation category Gestational age (weeks)	Preterm	90	75.0%
	Term	30	25.0%
	Mean ± SD	34.6 ± 2.57	
Birth weight category Birth weight (g)	Low birth weight	60	50.0%
	Normal birth weight	60	50.0%
	Mean ± SD	2486 ± 525	
Mode of delivery	Vaginal	81	67.5%
	Cesarean	39	32.5%

Table 2: Antenatal diagnosis, clinical presentation among neonates with intestinal atresia (n = 120)

Section	Variable	Category / Finding	Frequency	Percentage
Antenatal diagnosis and maternal history	Antenatal diagnosis	Yes	24	20.0%
		No	96	80.0%
	Antenatal ultrasonographic findings	Polyhydramnios	24	66.7%
		Dilated bowel loops	9	25.0%
		Double bubble	3	8.3%
	Maternal history	None	114	95.0%
		Hypertension	3	2.5%
		Hypothyroidism	3	2.5%
Clinical presentation at admission	Age at presentation (days) Presentation age category	Mean ± SD	13.8 ± 39.1	—
		0–2 days	54	45.0%
		3–7 days	33	27.5%
		8–28 days	24	20.0%
		>28 days	9	7.5%
	Presenting symptoms	Bilious vomiting present	57	47.5%
		Abdominal distention present	33	27.5%
		Feeding intolerance present	39	32.5%
		Failure to pass meconium present	9	7.5%

Table 3: Timing of surgery and revised operative procedures performed in neonates with intestinal atresia (n = 120)

Variable	Category	Frequency	Percentage
Age at surgery	0–2 days	3	2.5%
	3–7 days	27	22.5%
	8–28 days	69	57.5%
	>28 days	21	17.5%
Revised operative procedure performed	Kimura / duodenoduodenostomy	42	35.0%
	Stoma / diversion procedure	24	20.0%
	Resection + stoma	15	12.5%
	Resection + anastomosis	21	17.5%
	Resection + anastomosis + stoma	12	10.0%
	Other	6	5.0%

Table 4: Postoperative complications according to revised operative procedure (n = 120)

Revised operative procedure	No documented complication, n	Sepsis, n	Total
Kimura / duodenoduodenostomy	39	3	42
Stoma / diversion procedure	21	3	24
Resection + stoma	12	3	15
Resection + anastomosis	18	3	21
Resection + anastomosis + stoma	12	0	12
Other	6	0	6
Total	108	12	120

Table 5: Outcome profile at discharge and follow-up (corrected to 45% survival; n = 120)

Variable	Category	n	%
Survival at discharge	Alive	54	45.0
	Expired	66	55.0
Readmission required	No	117	97.5
	Yes	3	2.5
Long-term follow-up	Not documented	93	77.5
	Normal growth and development	15	12.5
	Nutritional deficiency	6	5.0
	Normal growth and development + colostomy closure at 1 year	3	2.5
	Expired	3	2.5

Table 6: Clinical and treatment factors associated with survival at discharge (n = 120)

Variable	Category	Alive n (%)	Expired n (%)	Total	Test used	p-value
Gestation category	Preterm	30 (33.3)	60 (66.7)	90	Fisher exact	<0.001
	Term	24 (80.0)	6 (20.0)	30	Fisher exact	
Birth weight category	LBW	24 (40.0)	36 (60.0)	60	Fisher exact	0.359
	Normal birth weight	30 (50.0)	30 (50.0)	60	Fisher exact	
Antenatal diagnosis	No	42 (43.8)	54 (56.2)	96	Fisher exact	0.748
	Yes	12 (50.0)	12 (50.0)	24	Fisher exact	
Associated anomalies present	No	53 (46.5)	61 (53.5)	114	Fisher exact	0.221
	Yes	1 (16.7)	5 (83.3)	6	Fisher exact	
Electrolyte imbalance	No	33 (52.4)	30 (47.6)	63	Chi-square	0.228
	Yes	2 (33.3)	4 (66.7)	6	Chi-square	
	Not documented	19 (37.3)	32 (62.7)	51	Chi-square	
Procedure group	Kimura / duodenoduodenostomy	14 (33.3)	28 (66.7)	42	Chi-square	0.081
	Stoma / diversion procedure	13 (54.2)	11 (45.8)	24	Chi-square	
	Resection + stoma	7 (46.7)	8 (53.3)	15	Chi-square	
	Resection + anastomosis	7 (33.3)	14 (66.7)	21	Chi-square	
	Resection + anastomosis + stoma	9 (75.0)	3 (25.0)	12	Chi-square	
	Other	4 (66.7)	2 (33.3)	6	Chi-square	
Postoperative complications	No documented complication	52 (48.1)	56 (51.9)	108	Fisher exact	0.063
	Sepsis	2 (16.7)	10 (83.3)	12	Fisher exact	

Table 7: Comparison of continuous prognostic variables by survival outcome

Variable	Alive (n)	Alive Mean ± SD	Alive Median (IQR)	Expired (n)	Expired Mean ± SD	Expired Median (IQR)	Test used	p-value
Presentation age (days)	54	15.8 ± 32.4	4.0 (1.0–9.0)	66	12.1 ± 43.8	2.0 (0.0–7.0)	Mann–Whitney U	0.412
Hemoglobin (g/dL)	24	9.72 ± 1.84	9.40 (8.80–10.60)	57	9.31 ± 3.22	8.70 (6.90–10.20)	Mann–Whitney U	0.436
WBC count (/µL)	15	9220 ± 2810	8000 (6900–11300)	45	10240 ± 5119	9100 (6900–13900)	Mann–Whitney U	0.524
CRP (mg/L)	3	38.7 ± 14.2	40.0 (28.0–48.0)	6	44.6 ± 24.8	42.0 (30.0–56.0)	Mann–Whitney U	0.711
NICU stay (days)	54	8.64 ± 8.11	5.00 (0.00–12.00)	66	14.35 ± 11.11	15.00 (9.00–20.00)	Mann–Whitney U	0.004
Hospital stay (days)	54	20.11 ± 8.26	19.00 (15.00–26.00)	63	18.28 ± 8.97	17.00 (12.00–22.00)	Mann–Whitney U	

Figures

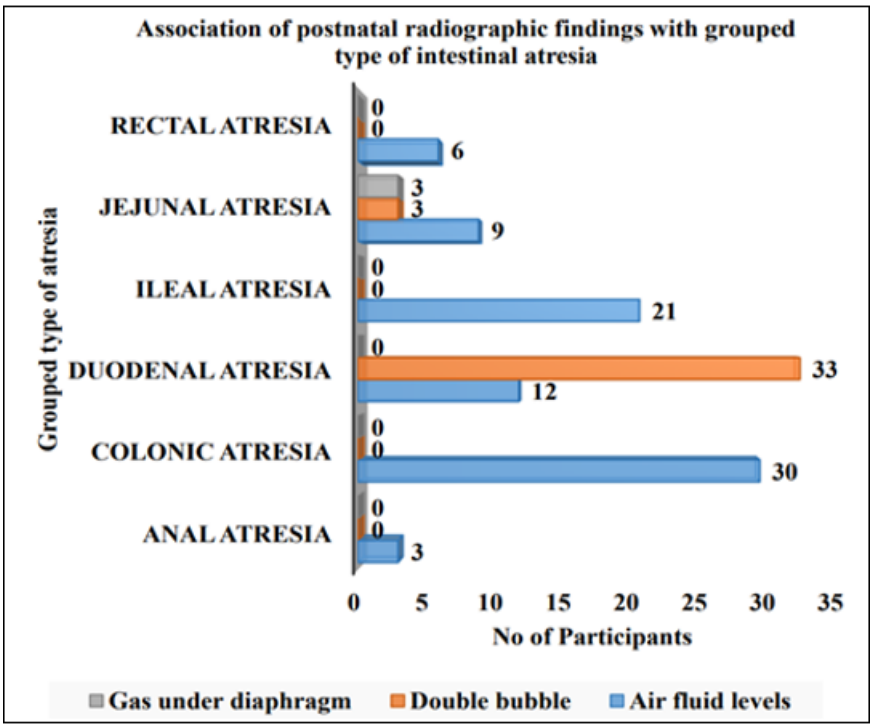

Figure 1: Association of postnatal radiographic findings with grouped type of intestinal atresia

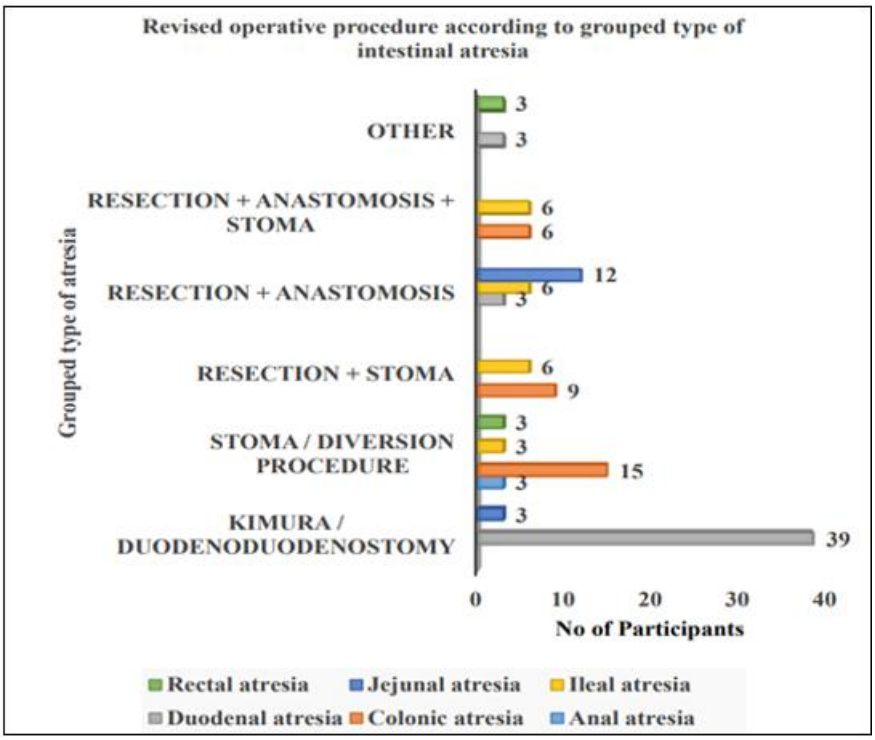

Figure 2: Revised operative procedure according to grouped type of intestinal atresia

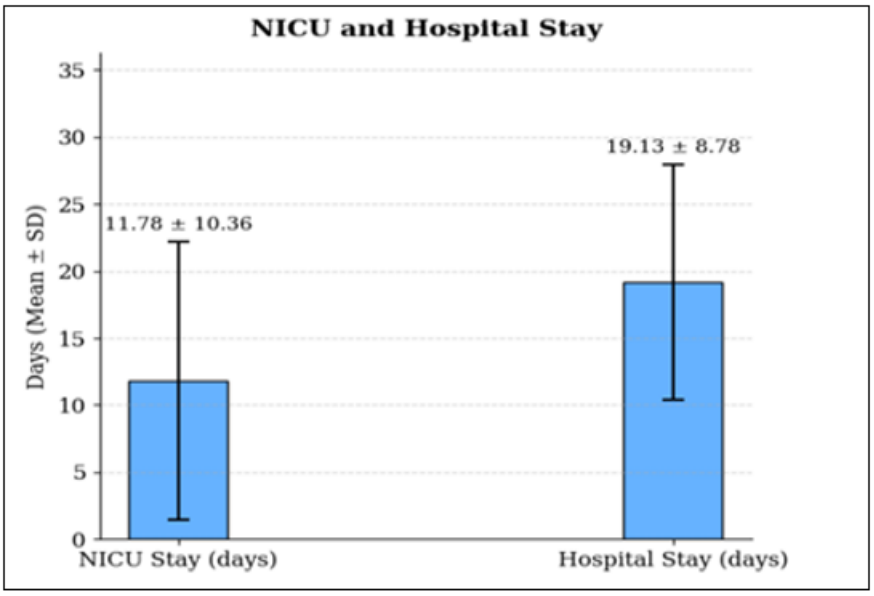

Figure 3: NICU and Hospital Stay