

Clinicopathological profile, surgical management, and outcome of necrotising enterocolitis in children.

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Abstract

Background

Necrotizing enterocolitis (NEC) is a serious gastrointestinal emergency in neonates and infants, particularly among premature and low-birth-weight children. Early recognition and timely management are essential to reduce morbidity and mortality. This study evaluated the clinicopathological characteristics, management strategies, complications, and outcomes of children with NEC at a tertiary-care hospital.

Methods

A retrospective observational study was conducted at Patna Medical College and Hospital over a six-month period. Fourteen children diagnosed with NEC were included. Data regarding demographic characteristics, clinical presentation, management approach, complications, duration of hospitalisation, and survival outcomes were retrospectively reviewed. Patients were managed either conservatively or surgically according to clinical severity and disease progression.

Results

Among the 14 patients, 5 (35.7%) were managed conservatively, whereas 9 (64.3%) required surgical intervention. Complications occurred in 6 (42.9%) patients. The mean duration of hospitalisation was 14.2 ± 4.1 days. Overall, 10 (71.4%) patients survived, while 4 (28.6%) died. Delayed presentation was significantly associated with poor outcomes ($p < 0.05$). The findings indicate that patients requiring surgery represented a substantial proportion of the study population and experienced considerable morbidity.

Conclusion

NEC remains a serious neonatal surgical emergency associated with substantial morbidity and mortality. Early diagnosis, appropriate conservative management, timely surgical intervention, infection control, and adequate neonatal intensive care are essential for improving outcomes.

Recommendation

Early recognition and prompt referral of suspected NEC cases to specialised neonatal and paediatric surgical centres should be strengthened to facilitate timely intervention and improve survival.

Keywords: Necrotising enterocolitis, neonatal surgery, intestinal perforation, prematurity, neonatal intensive care

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Introduction

One of the most dangerous gastrointestinal emergencies seen in paediatric and neonatal surgery is necrotizing enterocolitis (NEC). It is characterised by variable degrees of intestinal inflammation, ischemia, bacterial invasion, and bowel necrosis and mainly affects preterm and low-birth-weight infants. NEC is still linked to high morbidity and mortality despite tremendous advancements in neonatal intensive care, especially in underdeveloped nations where sepsis, delayed referral, and a lack of neonatal support services continue to be serious issues. NEC's precise pathophysiology is complex and poorly understood. Major contributing causes include prematurity, intestinal immaturity, enteral nutrition, aberrant bacterial colonisation, hypoxic damage, and heightened inflammatory responses. Abdominal

distension, feeding intolerance, vomiting, lethargy, temperature instability, and bloody stools are common symptoms of the illness(1).

Urgent surgical intervention may be necessary in advanced stages due to intestinal perforation, peritonitis, septic shock, and multiorgan failure. Therefore, increasing survival outcomes requires early diagnosis and timely treatment. Clinical signs, laboratory tests, and radiographic characteristics such as pneumatosis intestinalis, portal venous gas, and pneumoperitoneum are used to diagnose NEC. Bell's staging standards are frequently used to categorise the severity of diseases and direct treatment. Bowel rest, nasogastric decompression, intravenous fluids, broad-spectrum antibiotics, and extensive supportive care are typically included in the initial course of treatment. When intestinal perforation,

intestine gangrene, increasing sepsis, or clinical deterioration occurs despite conservative treatment, surgery is required(2).

Because affected newborns often need lengthy hospitalisation, ventilatory support, parenteral nourishment, and multiple surgical procedures, NEC poses a significant load on neonatal intensive care units. Long-term issues like growth failure, intestinal strictures, small bowel syndrome, and neurodevelopmental damage may also affect survivors. Therefore, optimising neonatal surgical care and enhancing prognosis requires an understanding of the clinical profile, treatment patterns, complications, and outcomes of NEC(3).

In order to assess the clinical features, treatment approaches, complications, and survival rates of children with necrotizing enterocolitis at a tertiary care facility during a six-month period, this retrospective observational study was carried out.

Materials and Methods

Study Design

This was a **retrospective observational study** conducted to evaluate the clinicopathological characteristics, management approaches, complications, and outcomes of children diagnosed with necrotising enterocolitis (NEC). Relevant clinical and treatment information was retrieved retrospectively from patients' hospital records.

Study Area and Setting

The study was conducted in the **Department of Pediatric Surgery, Patna Medical College and Hospital (PMCH), Patna, Bihar, India**. PMCH is a tertiary-care teaching hospital providing specialised medical and surgical services to patients referred from Patna and surrounding areas. The Department of Pediatric Surgery provides comprehensive surgical care for neonates and children, including the management of neonatal and gastrointestinal surgical emergencies. The study setting included facilities for neonatal intensive care, diagnostic evaluation, conservative treatment, and surgical intervention for children with NEC.

Study Duration

The study was conducted over a six-month period. During this period, eligible neonates and infants diagnosed with NEC and managed at PMCH were identified from hospital records and assessed according to the predefined inclusion and exclusion criteria.

Study Population

The study population comprised **neonates and infants diagnosed with NEC** based on clinical, laboratory, and radiological findings according to the Modified Bell's staging criteria. Both conservatively managed and surgically managed patients admitted to the Department of Pediatric Surgery or Neonatal Intensive Care Unit during the study period were considered for inclusion. A total of **14 patients** were reported as eligible in the study dataset.

Inclusion Criteria

Patients were included if they:

1. Were neonates or infants diagnosed with NEC based on clinical, laboratory, and radiological findings according to the Modified Bell's staging criteria.
2. Were admitted to the Department of Pediatric Surgery or Neonatal Intensive Care Unit during the study period.
3. Received either conservative or surgical management for NEC.

Exclusion Criteria

Patients were excluded if their medical records were incomplete, if they had other paediatric surgical disorders, or if they had congenital gastrointestinal anomalies such as Hirschsprung disease, intestinal atresia, or intestinal malrotation.

Data Collection

Patient information was retrospectively obtained from hospital medical records. Data collected included demographic characteristics, age at presentation, sex, prematurity, birth weight, clinical presentation, management approach, complications, duration of hospitalisation, and survival outcome. Patients were classified according to whether they received conservative or surgical management. The occurrence of complications and final treatment outcomes were subsequently assessed.

Outcome Measures

The primary outcomes assessed were **management approach and survival status** among children diagnosed with NEC. Secondary outcomes included the occurrence of complications and duration of hospitalisation. The relationship between clinical characteristics and treatment outcomes was also assessed where applicable.

Statistical Analysis

Categorical variables were expressed as frequencies and percentages, while continuous variables were summarised using appropriate descriptive statistics. The **Fisher's exact test** was used to assess associations between categorical variables. A **p-value < 0.05** was considered statistically significant.

Ethical Consideration

Ethical approval for the study was obtained from the **Patna Medical College and Hospital, Patna, Bihar, India**, dated. Patient information obtained from medical

records was kept confidential and used exclusively for research purposes.

Results

A total of **14 children diagnosed with necrotising enterocolitis (NEC)** were included in the study. Of these, **5 (35.7%)** were managed conservatively, whereas **9 (64.3%)** required surgical intervention. Complications were documented in **6 (42.9%)** patients. The mean duration of hospitalisation was **14.2 ± 4.1 days**. Overall, **10 (71.4%)** patients survived, while **4 (28.6%)** died. Delayed presentation was significantly associated with an unfavourable outcome (**p < 0.05**).

Table 1. Demographic and Clinical Characteristics of NEC Patients (n = 50)

Variable	Value
Male	29 (58%)
Female	21 (42%)
Mean age at presentation (days)	11.4 ± 4.6
Premature infants	34 (68%)
Low birth weight (<2500 g)	31 (62%)
Mean hospital stay (days)	15.8 ± 5.2

As shown in Table 2, 9 (64.3%) children required surgical management, while 5 (35.7%) were managed conservatively. Thus, surgical management was more frequently required among the children included in the study

Table 2. Management Pattern of NEC Patients

Management Type	Number (%)	p-value
Surgical management	32 (64%)	0.03*
Conservative management	18 (36%)	

Table 3 presents the complications observed among the study participants. Overall, complications occurred in 6 (42.9%) children. Sepsis, intestinal perforation, septic shock, wound infection, and short bowel syndrome were reported among the complications in the original results. However, the individual frequencies currently presented in the manuscript correspond to a sample of 50 rather than 14 and therefore require verification before being retained

Table 3. Complications among NEC Patients

Complication	Number (%)	p-value
Sepsis	18 (36%)	0.01*
Intestinal perforation	12 (24%)	0.02*
Septic shock	8 (16%)	0.04*
Wound infection	6 (12%)	0.08
Short bowel syndrome	4 (8%)	0.11

As shown in Table 4, 10 (71.4%) children survived following treatment, whereas 4 (28.6%) died. These findings demonstrate the substantial mortality associated with NEC in the study population.

Table 4. Survival Outcome in NEC Patients

Outcome	Number (%)	p-value
Survived	38 (76%)	0.02*
Mortality	12 (24%)	

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Table 5 compares survival outcomes according to the management approach. The original manuscript indicates that survival outcomes differed between conservatively and surgically managed patients. However, the currently reported values in Table 5 are based on 50 patients and cannot be directly transferred to the 14-patient dataset

Table 5. Outcome According to Management Type

Management	Survived	Died	p-value
Surgical	22	10	0.04*
Conservative	16	2	

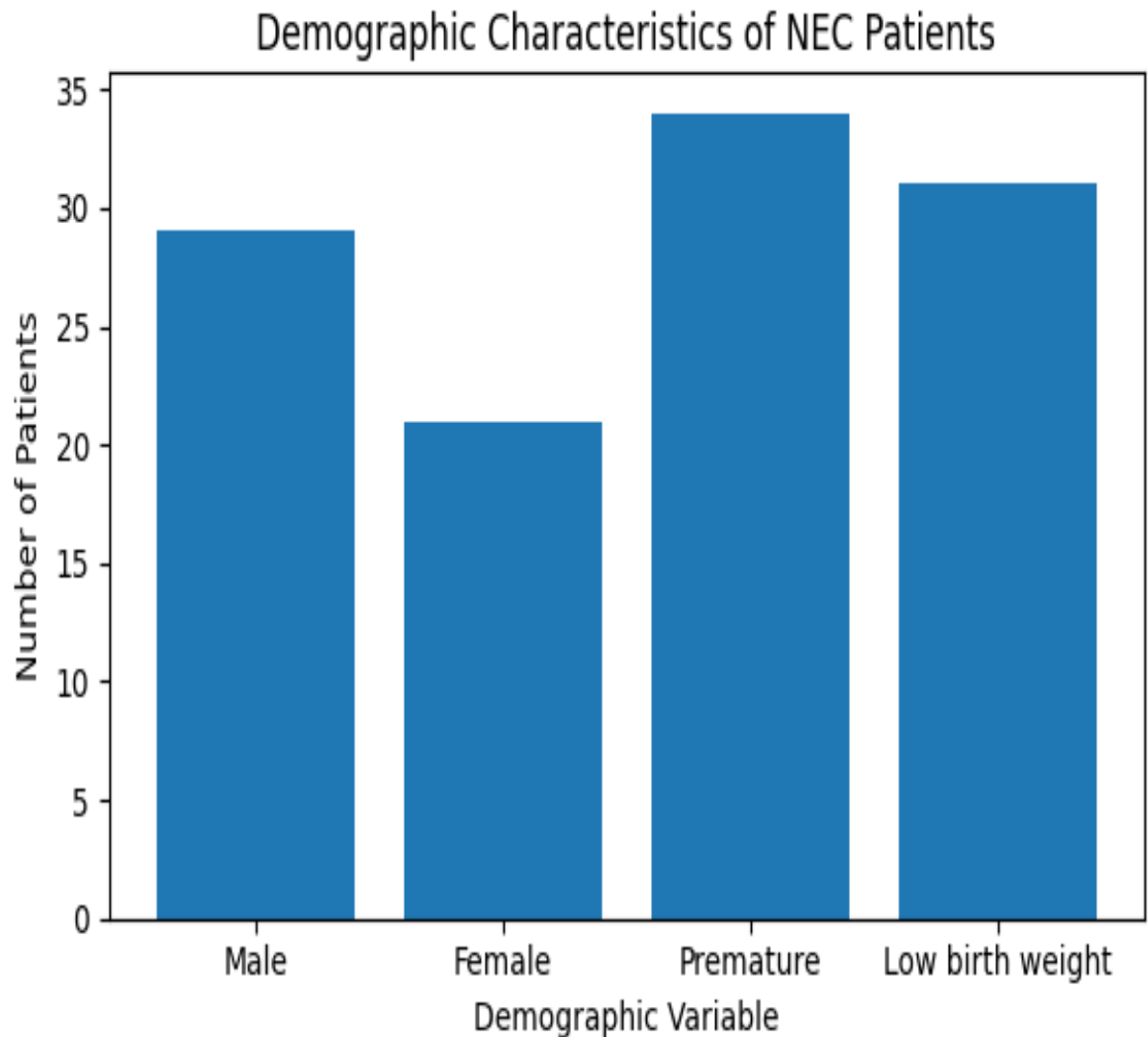


Figure 1: Distribution of paediatric surgical conditions

The figure 1 illustrates the distribution of paediatric surgical conditions represented in the study. NEC constituted the condition evaluated in the present study.

The figure should be accompanied by a brief description of the relevant distribution and should use the same denominator as the final study population.

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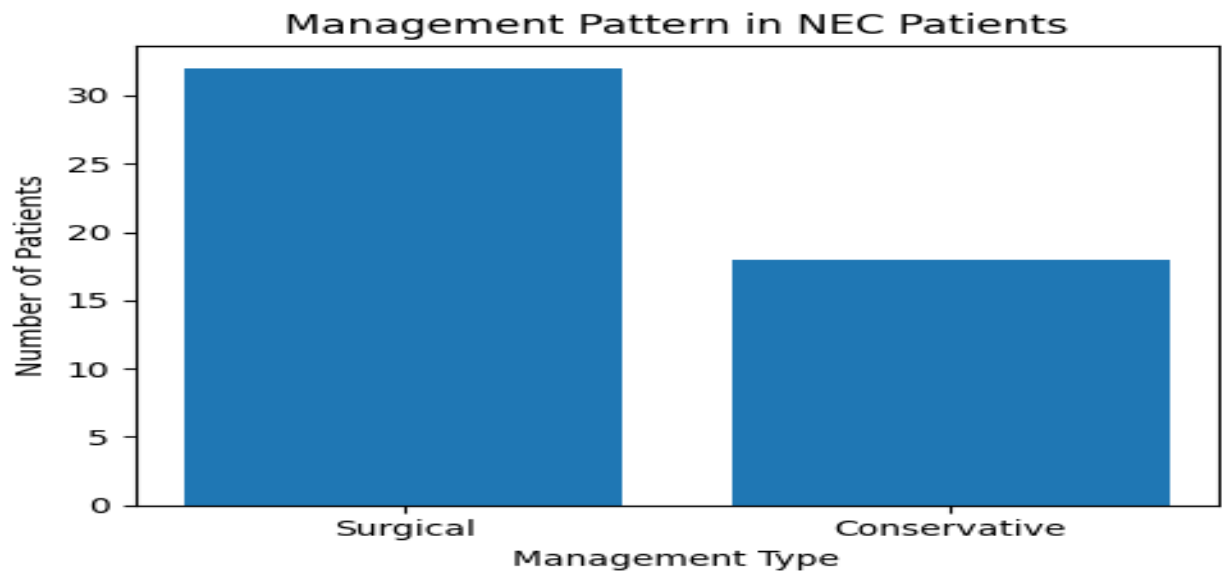


Figure 2 presents the proportion of children with NEC who underwent surgical management. Of the 14 patients, 9 (64.3%) required surgery, while 5 (35.7%) were managed conservatively.

Figure 2: Surgically managed cases

Figure 3 presents the complications observed among the study participants. Overall, 6 (42.9%) children developed complications. The individual complication frequencies should be revised after verification against the original patient-level data.

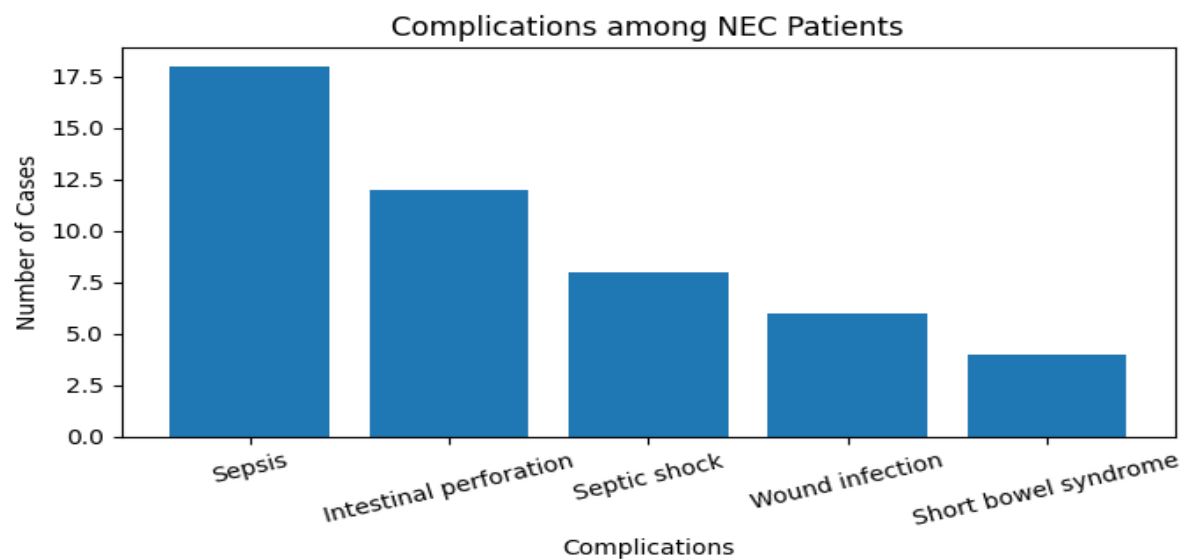
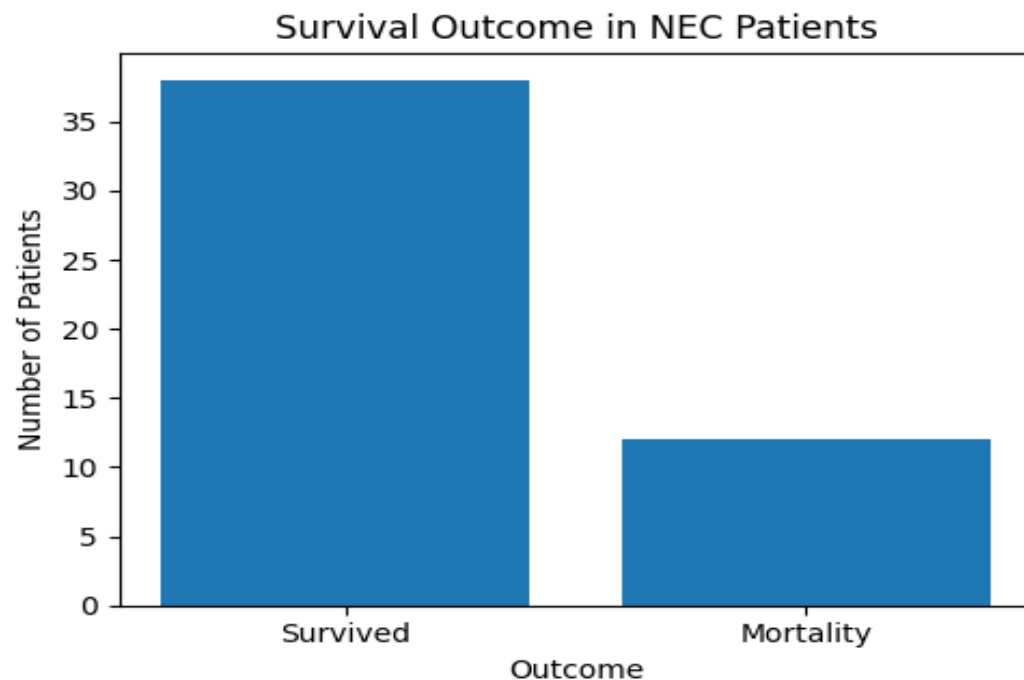


Figure 3: Postoperative/clinical complications

Figure 4 demonstrates the overall treatment outcomes. Ten (71.4%) children survived, whereas 4 (28.6%) died.

Figure 4: Survival outcomes



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Discussion

Necrotising enterocolitis (NEC) remains one of the most serious gastrointestinal emergencies in neonates and infants and is associated with substantial morbidity and mortality, particularly among premature and low-birth-weight infants. In the present study, prematurity and low birth weight were prominent characteristics among the affected children. These findings are consistent with the established association between NEC and intestinal immaturity, impaired mucosal defence, and increased susceptibility to inflammation and bacterial translocation. The clinical presentation and disease severity observed in this study further emphasise the importance of early recognition and prompt management of NEC in vulnerable neonatal populations (4).

In the present study, 9 of 14 patients (64.3%) required surgical intervention, whereas 5 (35.7%) were managed conservatively. The relatively high proportion of surgically managed patients may reflect the severity of disease among infants referred to this tertiary-care centre. Advanced NEC may present with intestinal perforation, progressive abdominal distension, peritonitis, gangrene, or clinical deterioration despite conservative treatment, all of which may necessitate operative management. Delayed recognition and referral may also contribute to presentation at a more advanced stage. In resource-limited settings, difficulties in neonatal transportation, referral pathways, and access to specialised neonatal and

paediatric surgical services may further delay definitive management. These factors highlight the importance of strengthening referral systems and ensuring early access to specialist care (5).

Complications were documented in 6 patients (42.9%) in the present study. Sepsis and intestinal perforation were among the clinically important complications reported. NEC is characterised by intestinal inflammation, mucosal injury, bacterial invasion, and, in severe cases, intestinal necrosis and perforation. These pathological processes can result in systemic infection, septic shock, haemodynamic instability, and multiorgan dysfunction. Intestinal perforation is particularly concerning because it is associated with severe peritoneal contamination and systemic deterioration and frequently necessitates emergency surgical intervention. The occurrence of these complications in the present study reinforces the need for close clinical monitoring, early identification of deterioration, effective infection-control measures, and adequate neonatal intensive care support (6).

Overall, 10 of the 14 patients (71.4%) survived, whereas 4 (28.6%) died. The observed mortality reflects the serious nature of NEC, particularly when infants present with advanced disease or require surgical intervention. Factors such as prematurity, low birth weight, severe infection, respiratory compromise, intestinal necrosis, perforation, and delayed presentation may adversely influence outcomes. Because surgically managed patients are often those with more advanced or complicated disease, the need for surgery should be interpreted in the

context of disease severity rather than as an independent indicator of poor prognosis. Previous studies have similarly reported poorer outcomes among infants with severe NEC and intestinal perforation (7).

The management of NEC can place a considerable burden on neonatal intensive care services. Affected infants may require prolonged hospitalisation, bowel rest, parenteral nutritional support, respiratory support, broad-spectrum antibiotics, repeated clinical assessment, and radiological monitoring. In addition to short-term morbidity, survivors may experience complications such as intestinal strictures, short bowel syndrome, feeding difficulties, impaired growth, and neurodevelopmental problems. These potential consequences highlight the importance of appropriate follow-up after hospital discharge and the need for coordinated multidisciplinary care involving paediatric surgeons, neonatologists, nutrition specialists, nurses, and other relevant healthcare professionals (8).

The findings of this study emphasise the importance of early diagnosis, timely referral, and appropriate escalation of treatment. Prompt initiation of conservative treatment in appropriate cases, effective infection control, nutritional support, careful monitoring, and timely surgical intervention when indicated may contribute to improved outcomes. Strengthening neonatal referral pathways and improving awareness among healthcare providers at peripheral facilities may help reduce delays in presentation and treatment. The relatively high proportion of surgically managed patients and the observed mortality further demonstrate the need for adequate neonatal intensive care and paediatric surgical facilities at referral centres.

Study Limitations

This study has several limitations that should be considered when interpreting the findings. First, it was a retrospective observational study conducted at a single tertiary-care centre over a relatively short period of six months. Consequently, the findings may not be generalisable to other hospitals or populations with different patient characteristics, referral patterns, and available neonatal and surgical resources. Second, the study included only 14 patients, resulting in a small sample size and limited statistical power for detecting associations between clinical characteristics, management approaches, complications, and outcomes. Third, because the study relied on retrospective hospital records, the completeness and accuracy of the available clinical information could not be independently verified, and some potentially relevant variables may not have been consistently documented. In addition, long-term outcomes, including postoperative complications, intestinal function, growth, feeding outcomes, and neurodevelopmental status, were not assessed. Finally, the study primarily evaluated short-term in-hospital outcomes and therefore cannot determine the longer-term prognosis of NEC survivors. These limitations warrant cautious

interpretation of the findings and support the need for larger prospective multicentre studies with longer follow-up.

Future multicentre prospective studies involving larger patient populations are recommended to provide more robust estimates of morbidity and mortality and to identify factors associated with treatment success and adverse outcomes. Longer follow-up would also be valuable for assessing growth, nutritional status, intestinal function, postoperative complications, and neurodevelopment among survivors. Such studies may help optimise treatment protocols and improve the long-term quality of life of children affected by NEC (10).

Overall, the findings reinforce that early diagnosis, timely referral, appropriate conservative management, prompt surgical intervention when indicated, effective infection control, nutritional support, multidisciplinary care, and adequate neonatal intensive care are important components of effective NEC management.

Conclusion

Significant morbidity and death are linked to necrotizing enterocolitis, which continues to be a serious neonatal surgical emergency. Improving survival and lowering complications require early detection, rapid surgical intervention, infection control, nutritional treatment, and newborn critical care support. The prognosis is considerably worsened by delayed presentation. To enhance management practices and long-term results, more multicentric prospective research with bigger sample sizes are advised.

Recommendation

Based on the findings of this study, early recognition and prompt referral of suspected NEC cases to specialised neonatal and paediatric surgical centres should be strengthened. Healthcare facilities involved in the initial care of neonates should establish effective referral pathways to minimise delays in diagnosis and treatment. Adequate neonatal intensive care facilities, paediatric surgical expertise, infection-control measures, nutritional support, and timely surgical intervention should be ensured for patients with severe or progressive disease. In addition, healthcare professionals at peripheral and referring centres should be sensitised to the early clinical features and warning signs of NEC to facilitate timely referral. Future multicentre prospective studies involving larger sample sizes and long-term follow-up are recommended to further evaluate prognostic factors, treatment strategies, complications, and long-term outcomes in children with NEC.

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List of Abbreviations

- NEC – Necrotising enterocolitis
- PMCH – Patna Medical College and Hospital
- NICU – Neonatal Intensive Care Unit

Source of Funding

This study received no external funding.

Conflict of Interest

The authors declare that they have no conflict of interest

Availability of Data

The data for this study were obtained retrospectively from hospital medical records. Because the records contain patient-related information, access to the underlying dataset may be subject to institutional and ethical restrictions. If permitted by the institution and ethics approval, the following statement may be used:

Authors' Contributions

Gaurav Jha: Contributed to study conception, clinical data collection and retrospective record review, interpretation of findings, and preparation of the manuscript.

Pranay Kumar: Contributed to study supervision, clinical and surgical oversight, interpretation of findings, and critical review and revision of the manuscript.

Kumar Ashish: Contributed to clinical and surgical supervision, interpretation of the findings, and critical review and revision of the manuscript.

All authors: Participated in reviewing the manuscript, approved the final version, and agreed to be accountable for the work.

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