Original Research Article

Predictors of Morbidity and Mortality of Gastrointestinal Perforation inChildren

ABSTRACT

Background: *Gastrointestinal perforation is a common surgical problem in paediatric surgical ward in our country. It carries a high morbidity and mortality in children. The predictors of postoperative morbidity and mortality are still not well established.* ***Objectives:*** *The objective of this study was to identify the predictors of morbidity and mortality following surgery for gastrointestinal perforation in children.* ***Methods:*** *This was a single centre cross sectional type of descriptive observational study carried out in the Department of Paediatric Surgery, Mymensingh Medical College Hospital with 16-month duration from 1st January, 2017 to April 30, 2018, in children aged from 2-12 years. Predictors related to postoperative morbidity and mortality were investigated.* ***Results:*** *A total of 40 patients were selected for this study with mean age of 8.92±2.61 years. Male: female was 1.5:1. Analysis indicated that factors associated with postoperative morbidity and mortality were low BMI, poor nutritional status, low serum total protein and albumin, delay in seeking treatment and contaminated peritoneal collection. Appendicular perforation was the highest number perforation in 23(57.5%) patients. Ileal perforation was the second highest number 8(20%). Appendectomy was the highest surgical procedure 21(52.5%), followed by resection-anastomosis and wound excision & repair 3(7.5%) each. Serum total protein and albumin were below normal limit among 15(37.5%) and 35(87.5%) patients respectively. 13(32.5%) patients received treatment 72 hours after onset of symptom and 18(45%) patients undergone operation within 24-48 hours of admission. Postoperative complications developed in 30 patients. Among them SSI were in 20(66.66%), SIRS in 9(30%) and leakage of repair in 1(3.33%) patient. Mortality rate was 5%.* ***Conclusion:*** *Poor nutritional status, low total serum protein and albumin, delay in initiation of treatment, and contaminated peritoneal fluid are the predictors of morbidity and mortality of gastrointestinal perforation in children.*

Key words: Predictors, Gastrointestinal perforation, Children, Serum protein and albumin, feculent peritonitis.

Introduction

Gastrointestinal perforation in children is a frequently encountered surgical problem in Bangladesh. It is a major life-threatening condition with high morbidity and mortality that requires immediate surgical intervention[1]. Although there is improved understanding of pathophysiology of perforationand better surgical and postoperative management, the overall mortality rate is 30%. Diffuse peritonitis causes high mortality up to 70% cases[1].

The clinical predictors of post-operative morbidity and mortality are still not well established[1]. A timely and accurate diagnosis and prompt delivery of appropriate treatment is the gold standard for the favourable outcome in patients with gastrointestinal tract perforation[2].The aetiological factors of gastrointestinal tract perforation are numerous and varied. Appendicular perforation is the leading cause in children. Schooler GR et al. 2016 [3] shown in their study the causes were inflammatory (64%), traumatic (20%), miscellaneous like Meckel's diverticulum, intussusceptions, & foreign body ingestion (12%) and malignant (4%)[3].Spontaneous bowel perforation in neonates, infants and children occurred in stomach and small bowel, colonic in neonatal necrotizing enterocolitis (NEC), Hirschsprung's disease and anorectal malformation. Small bowel perforation also encountered in intestinal atresia and meconium ileus diseases and abdominal trauma. Iatrogenic injury during gastrointestinal surgery and endoscopic procedures and ingestion of caustic substances are not infrequent causes[4].

Clinical presentations of gastrointestinal perforation in children include pain, or unusual cry, bilious vomiting, abdominal distension, dehydration, tense abdomen. Features of hypovolemic and septic shock are found in late presentation. Presentations are not the same as in adults[5].Imaging assessment in patients with suspected gastrointestinal tract perforation plays a central role in making the diagnosis and follow-up evaluation.A wide range

of imaging techniques are available. The most frequently used are abdominal radiographs, ultrasonography, fluoroscopy, and computed tomography (CT).

Abdominal and pelvic radiographs are usually the first imaging studies conducted in the paediatric patients clinically suspected of gastrointestinal tract pathology[3].The ultrasound is an initial method for most acute abdominal conditions. It is useful for detection of free fluid of various densities depending on the colour of grey scale[6].

Radiological findings includes free gas under diaphragm (32%), fluid and gas level in the abdomen (20%), only gaseous distension of abdomen (32%) and hazy abdomen (16%). Native x-ray of abdomen showed free air in the abdominal cavity in 80% cases. Ultrasound showed positive results on free fluid in 90% and CT scan revealed both free liquid and air in 100% cases[6].Preoperative resuscitation, techniques of surgery, antibiotic regimen, and maintenance of fluid and electrolytes in postoperative care remain amenable to improvement. With the availability of modern antibiotics, safe anaesthesia and surgical procedures, the morbidity and mortality due to gastrointestinal perforation in children have reduced significantly in recent years[5].

The postoperative complications following gastrointestinal perforation include surgical site infection, leakage from repair or anastomosis, intraperitoneal sepsis and systemic inflammations. These complications are higher than abdominal surgeries for other causes[1].Mortality depends on time of initiation of treatment, nutritional status & haemodynamic status, condition of the bowel, degree of peritoneal contamination and associated pre-operative co-morbid risk factors. Deaths occur in older children due to sepsis, multi organ failure and immunodeficiency [7].

Low serum protein albumin are also related with morbidity and mortality in gastrointestinal perforation [1].Delay in diagnosis and initiation of treatment had been significantly correlated to outcome. Prolonged time from the onset of disease to surgical management was previously linked to poor prognosis and higher mortality [8].

In this study we would like to identify predictors of morbidity and mortality of gastrointestinal perforation in children.

Methods

This was a cross-sectional prospectivestudy, carried out in the Department of Paediatric Surgery, Mymensingh Medical College Hospital, Mymensingh, Bangladesh, from January, 2017 to April, 2018. The study was conducted among 2-12 years aged children with gastrointestinal tract perforation. A total of 40 patients were evaluated, who fulfilled the inclusion criteria. After admission all patients were evaluated by taking detailed history from patients and their guardians. Clinical examination and relevant imaging and laboratory investigations were performed. The patients were resuscitated and planned for surgical intervention. Informed consent were taken from parents or guardians after explaining the purpose of the study. Any change of treatment during surgery depends on nature of the lesion and condition of the patient. In this regard risk bond consent was taken from each and every patient's guardian.

All patients underwent laparotomy under general anaesthesia. Treatment modalities were adopted according to type and nature of the lesion. Procedures were appendectomy, wound excision and repair of perforation with or without proximal bowel exteriorization, resection and anastomosis with or without proximal bowel exteriorization. Postoperative findings were documented. Patients were closely monitored postoperatively and findings were recorded. Laboratory investigations and imaging were done in postoperative period where needed. Postoperative findings were noted and appropriate measures were taken in all events. Data were analysed to obtain the result by standard statistical formula by using computer-based software, SPSS, version 20. P value <0.05 was considered as significant.

Results

This cross sectional descriptive observational study was carried out in the Department of Paediatric Surgery, Mymensingh Medical College Hospital during the period of January, 2017 to April, 2018. A total of 40 patients were included in this study. Among them 24 were male and 16 were female with the ratio of male: female 1.5: 1. The age ranges from 2 years to 12 years with the mean age of 8.92 ± 2.61 year

The mean BMI of the patients was 13.57 and SD 1.76. Maximum 23(57.5%) patients' perforation was found in appendix, followed by 8(20%) perforations in ileum and 4(10%) in jejunum (Table 2). The mean BMI of the patients was 13.57 and SD 1.76. Maximum 23(57.5%) patients' perforation was found in appendix, followed by 8(20%) perforations in ileum and 4(10%) in jejunum (Table 2).

Regarding operative procedure Maximum 21 (52.5%) appendectomy was performed, followed by 3 (7.5%) resection and anastomosis and wound excision and repair each. Wound excision and repair: in case of traumatic perforation. Repair with omental patch: in case of duodenal ulcer perforation. Among 40 patients 20 (50%) patients developed SSI followed by SIRS in 9 (22.5%) patients. Postoperative leakage of repair was observed in 1 (2.5%) patient (Table 1).

Among 40 patients 22(55%) were in average nutritional status; among them 8(36.36%) patients developed SSI and 5(22.72%) patients suffered from SIRS. On the other hand, 18 patients were in poor nutritional condition; where 12(66.66%) and 4(22.22%) patients suffered from SSI and SIRS respectively (Table 2).The mean BMI of the patients was 13.57 and SD 1.76. Among the patient studied, appendix was found to be perforated in maximum(57.5%) no of cases, followed by 8(20%) perforations in ileum and 4(10%) in jejunum (Table 2). Regarding operative procedure appendicectomy was found to be performed in maximum(52.5%) cases, followed by 3(7.5%) resection & anastomosis and wound excision & repair each. Wound excision and repair: in case of traumatic perforation. Repair with omental patch: in case of duodenal ulcer perforation. Among 40 patients 20 (50%) patients developed SSI followed by SIRS in 9 (22.5%) patients. Postoperative leakage of repair was observed in 1 (2.5%) patient (Table 1). Among 40 patients 22(55%) were in average nutritional status; among them 8(36.36%) patients developed SSI and 5(22.72%) patients suffered from SIRS. On the other hand, 18 patients were in poor nutritional condition; where 12(66.66%) and 4(22.22%) patients suffered from SSI and SIRS respectively (Table 2).

Table 1: Postoperative Complications (N=40)

Postoperative Complication	Surgical Site Infection(SSI)	Leakage	SIRS
Yes	20 (50%)	1 (2.5%)	9 (22.5%)
No	20 (50%)	39 (97.5%)	31(77.5%)
Total	40 (100%)	40 (100%)	40 (100%)

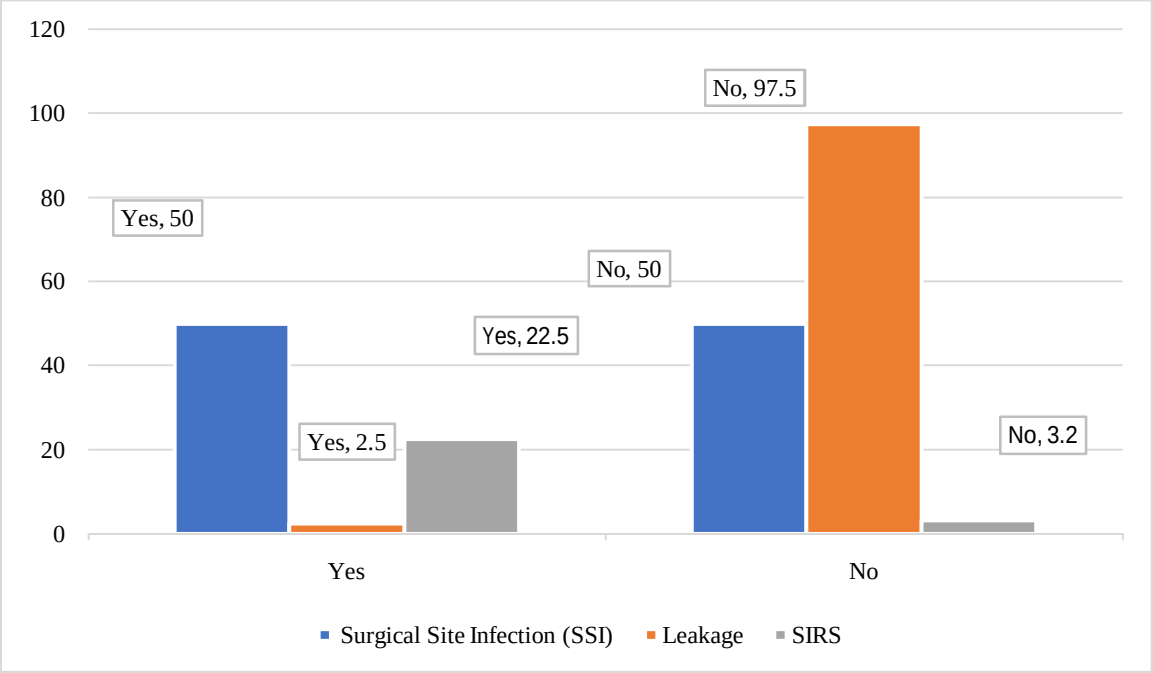

Figure I: Column Chart Showed Distribution of Postoperative Complications by patients(N=100)

Table 2: Association between Nutritional Status and Morbidity and Mortality (n=40)

Nutritional Status	No. of patients	SSI	Leakage	Leakage	Death
Average	22 (55%)	8(36.36%)	0 (0%)	5(22.72%)	0 (00%)
Poor	18 (45%)	12(66.66%)	1 (5.55%)	4(22.22%)	2(11.11%)
Total	40 (100%)	20 (50%)	1 (2.5%)	9 (22.5%)	2(5%)

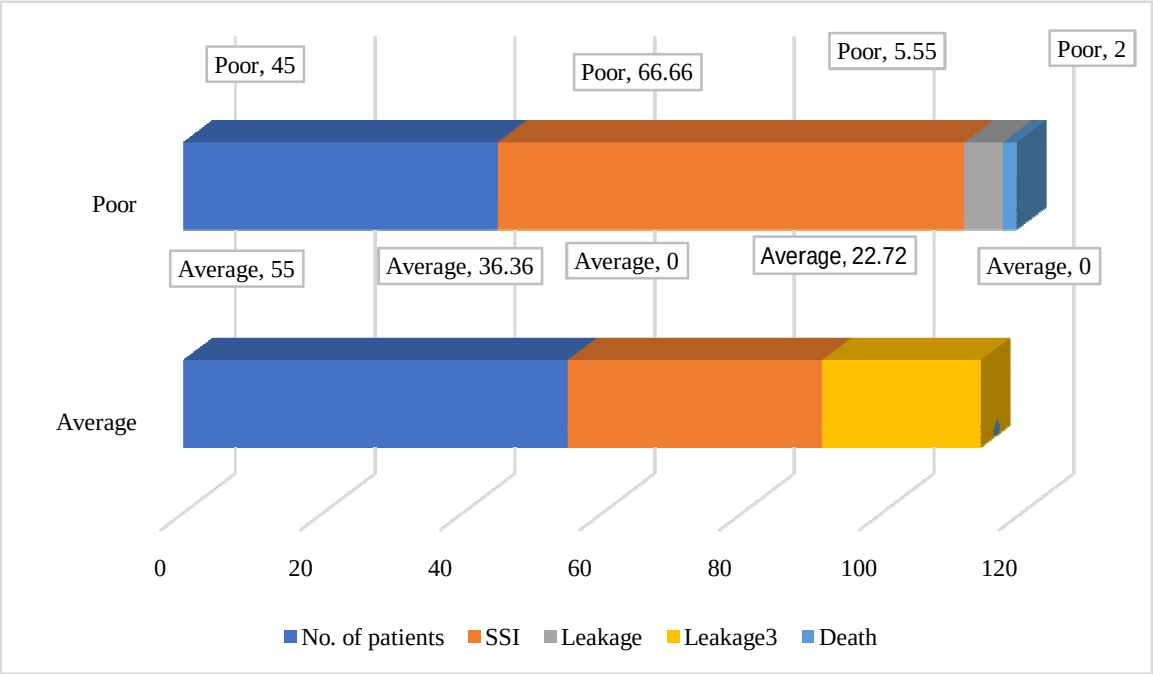

Figure II: Column Chart Showed Distribution of Morbidity and Mortalitybypatients(N=100)

15(37.5%) patients had serum total protein <5.5 gm/dl. Among them 10(66.66%) and 3(20%) patients developed SSI and SIRS respectively. Mortality was 1(6.66%).

On the other hand, 25(62.5%) patients' total protein was ≥5.5gm/dl. Among them SSI was observed in 10(40%) patients followed by SIRS in 6(24%) patients. Mortality was 1(4%) (Table 3).

Table 3: Relationship between Total Serum Protein and Postoperative Morbidity and Mortality (n=40).

Serum total protein(gm/dl)	No. of patients	SSI	Leakage	SIRS	Death
<5.5	15(37.5%)	10(66.66%)	0(00%)	3(20%)	1(6.66%)
≥5.5	25(62.5%)	10(40%)	1(4%)	6(24%)	1(4%)
Total	40(100%)	20(50%)	1(2.5%)	9(22.5%)	2(2.5%)

35(87.5%) patients had serum albumin <3.5 gm/dl and only 5(12.5%) patients had ≥3.5 gm/dl. Among former group 19 (54.28%) patients developed SSI, followed by SIRS in 8(22.86%) patients and leakage in 1(2.86%). Mortality was 2(5.71%). But in the later group only 1(20%) patient developed SSI and SIRS each (Table 4).

Table 4: Relationship between Serum Albumin and Postoperative Morbidity and Mortality (n=40)

Serum albumin(gm/dl)	No. of Patients	SSI	Leakage	SIRS	Death
<3.5	35(87.5%)	19(54.28%)	1(2.86%)	8(22.86%)	2(5.71%)
≥3.5	5(12.5%)	1(20%)	0(00%)	1(20%)	0(00%)
Total	40(100%)	20(50%)	1(2.5%)	9(22.5%)	2(5%)

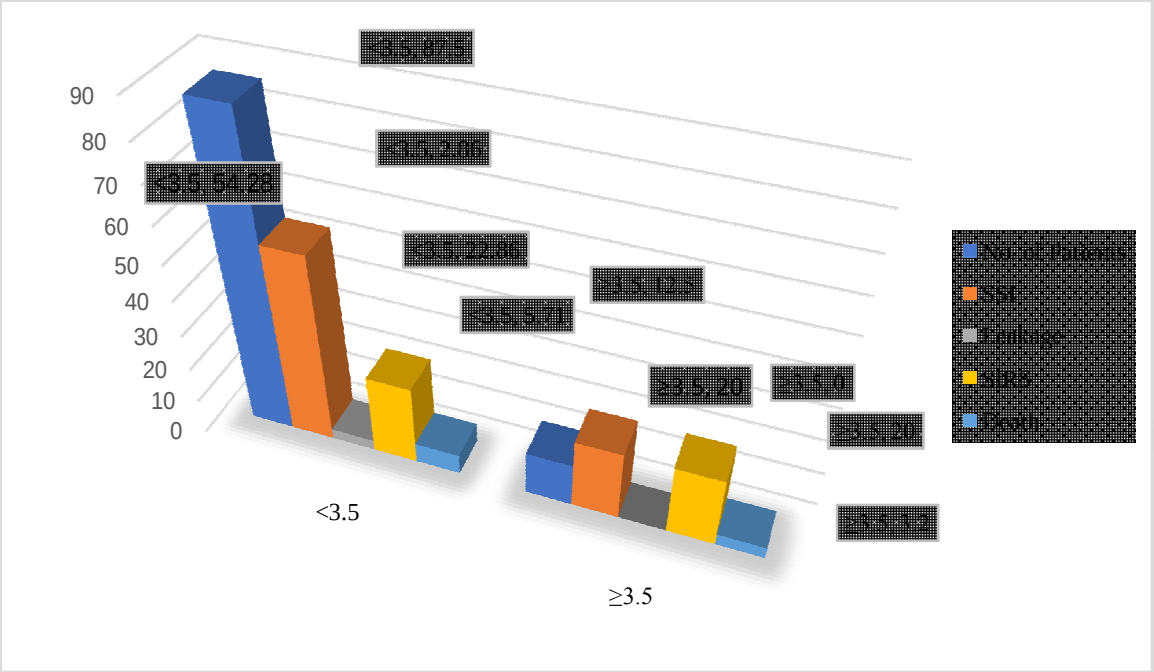

Figure:III: Column Chart Showed Distribution of Serum Albumin and Postoperative Morbidity and Mortalitybypatients(N=100)

Table 5 shows that 27(67.5%) patients sought treatment in <72 hours of symptom onset. Among them 11(40.74%) and 5(18.51%) patients developed SSI and SIRS respectively. Mortality rate was 7.40%. On the other hand, 13(32.5%) patients admitted ≥72 hours of symptom onset. Among them 9(69.23%) and 4(30.77%) patients were found to have developed SSI and SIRS respectively.

Table 5: Relationship of Postoperative Morbidity and Mortality with Delay in Seeking Treatment (n=40).

Delay in seeking treatment	No. of patients	SSI	Leakage	SIRS	Death
<72 hours	27(67.5%)	11(40.74%)	1(3.70%)	5(18.51%)	2(7.40%)
≥72 hours	13(32.5%)	9(69.23%)	0(00%)	4(30.77%)	0(00%)
Total	40(100%)	20(50%)	1(2.5%)	9(22.5%)	2(5%)

Among 13(32.5%) patients having feculent peritoneal fluid, SSI and SIRS were observed in 5(38.46%) and 3(23.07%) patients respectively. Mortality rate 7.69% (Table 6).
On the other hand, 27(67.5%) patients having non-feculent peritoneal fluid, 15(55.55%) and 6(22.22%) patients were found to have developed SSI and SIRS respectively. Mortality rate 3.70% (Table 6).
38(95%) patients recovered with or without morbidity. Mortality rate was 5%

Table 6: Relationship between type of Peritoneal Fluid and Postoperative Morbidity and Mortality

Type of peritoneal fluid	No. of patients	SSI	Leakage	SIRS	Death
Feculent	13(32.5%)	5(38.46%)	1(7.69%)	3(23.07%)	1(7.69%)
Non-feculent	27(67.5%)	15(55.55%)	0(00%)	6(22.22%)	1(3.70%)

Total	40(100%)	20(50%)	1(2.5%)	9(22.5%)	2(5%)

Discussion

Gastrointestinal perforation in children is a frequently encountered surgical problem. The clinical predictors of postoperative morbidity and mortality are still not well established.A timely and accurate diagnosis, appropriate resuscitation, meticulous operative technique and proper postoperative care are necessary to ensure acceptable rate of morbidity and mortality[2].A total of 40 patients with gastrointestinal perforation in children were selected in this study. Age range was 2-12 years with mean age of 8.92±2.61 years. Maximum 14(35%) patients were in 8-10 years age group. In 2003, Talukder SA et al.reported mean age 6.97±3.59 years in their study[5].

The mean weight and height of the patients were 22.23±6.73 kg and 1.27±0.16 meter respectively, which were not included in other studies so far cited.In the present study maximum number of perforations was in appendix 23(57.5%). Singh M et al.in a study showed maximum sites of perforation in appendix 21.5% [9]. 8 (20%) perforations were in ileum and 4(10.00%) in jejunum which is consistent with the study done by Akireddy GRG et al. which showed perforations in jejuno-ileal region (17%), which rationalized the present study[2]. Appendectomy 21(52.5%) was the most common surgical technique in the present study which was more or less consistent with other study such as Global Surg Collaborative, (68%), followed by resection-anastomosis 3(7.5%), wound excision and repair 3(7.5%) and resection-ileostomy 2(5%)[10]. Hodonou MA et al.in a study showed resection-anastomosis 31.3%, wound excision and repair 67.7%, and resection-ileostomy 1%[11]. These findings were not consistent with other study due to the limitation of the present study.

In the present study postoperative complications developed in 30 patients, among them SSI were in 20(66.66%), leakage in 1(3.33%) and SIRS in 9(30%) patients. Akireddy GRG et al. showed SSI were 94.74% in their study[2]. On the other hand, Aliyu S et al. study reported SSI 21.64%[12]. Also Hodonou MA et al.found it 45.5% in their study[11]. This finding varied in different studies, which were more or less consistent with the present study.

In this study average nutritional status was in 22(55%) patients. Among them SSI and SIRS developed in 8(36.36%) and 5(22.72%) patients respectively. On the other hand 18(45%) patients were in poor nutritional condition, where 12(66.66%) and 4(22.22%) patients suffered from SSI and SIRS respectively. In Aliyu S et al. and in, Global Surg Collaborative [10]reported SSI and SIRS 21.64% and 20% respectively[12]. This parameter was not consistent with other studies.

Serum total protein was <5.5 gm/dl in 15(37.5%) patients. Among them SSI developed in 10(66.66%) and SIRS in 3(20%) patients respectively, which was not consistent with other studies. Serum albumin was <3.5 gm/dl in 35(87.5%) patients. Among them 19(54.28%) patients developed SSI and 8(22.86%) patients developed SIRS and leakage in 1(2.86%) case. These findings were not in consistent with other studies.

The present study showed that 27(67.5%) patients received treatment <72 hours of symptom onset. Among them SSI and SIRS developed in 11(40.70%) and 5(18.51%) patients respectively. 13(32.5%) patients admitted ≥72 hours after symptom onset. Among them 9(69.23%) developed SSI and 4(30.77%) patients developed SIRS. These findings are in consistent with other studies such as Hodonou MA et al. [11], and Global Surg Collaborative , Hodonou MA et al. reported morbidity 62.6% dominated by surgical site infection with 45.5%[10,11]. The mortality rate was 11.1%.

This study shows that 27(67.5%) and 13(32.5%) patients had non-feculent and feculent peritoneal fluid respectively. Patients having feculent fluid SSI and SIRS were observed in 5(38.46%0 and 3(23.07%) patients respectively. But patients having non-feculent peritoneal fluid 15(55.55%) and 6(22.22%) patients were found to have developed SSIand SIRS respectively. Mortality was equal in both groups. The findings are statistically not significant, it is an independent risk factor. Postoperative morbidity and mortality are associated with other predictors which were revealed in this study. In Shin et al. [1] also shown it independently associated with complications. Hodono MA et al. noted that all the deceased patients had fecaloid or purulent fluid, and that fecaloid aspect influences mortality[11].

In the present study 38(95%) patients recovered after surgery with or without morbidity. In our study mortality rate was 5% which is similar to other studies [2], [10].

Overall, this study is consistent with other studies in terms of age, sex, nutritional status, protein profile, sites, procedure, preoperative findings and postoperative complications of gastrointestinal perforation in children.

Conclusion:

Poor nutritional status, low total serum protein and albumin, delay in initiation of treatment, and contaminated peritoneal fluid are the predictors of morbidity and mortality of gastrointestinal perforation in children.

Disclaimer (Artificial intelligence)

No generative AI technologies were used in writing or editing this manuscript.

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