

Prospective Study of Patients Presenting With Small Bowel Perforations and Outcome in A Rural Hospital In South India

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Abstract:

Introduction: The wide spectrum of etiologies resulting in small intestinal perforation with nonspecific clinical picture poses a challenge for the diagnosis to the general surgeon. The delayed diagnosis thereby delays the management leading to high morbidity and mortality. This study was an attempt to find out the common causes of small bowel perforation and outcome. The prevalence of small bowel perforation in the selected population remains unknown. Hence considering the frequency of small bowel perforation the sample size was estimated based on formula Sample size (n) = $4pq/d^2$

Aims & Objectives: To study the causes of small bowel perforation and To study the mortality and outcome of small bowel perforations.

Results: In this study male preponderance was note with 68% of males and male to female ratio of 2.12:1. The commonest age group was 31 to 40 years (39%) and the mean age was 33.97 ± 13.93 years. Abdominal pain was the commonest presenting complaint (85%), dehydration was the common clinical sign (24%) and abdominal examination revealed tenderness in majority of the patients (86%). Single perforation was noted in 79% of the patients. The causes of the perforation were typhoid (38%), tuberculous perforation (22%) and non specific (27%). During post operative course blood transfusion was required in 15%, reversal in 14%, protein supplementation in 5% and amino acid transfusion in 3% of the patients while complications were present in 19% of the patients and majority of the patients had wound infection (94.74%). The mortality was noted in 4% of the patients. Age was significantly associated with causes of perforation ($p=0.004$) and ileocaecal perforation was associated with maximum complications ($p<0.001$).

Conclusion: Non traumatic small bowel perforations are widely prevalent with infectious etiology that is, typhoid and tuberculosis. Early diagnosis and management result in favourable outcome among the patients with small bowel perforation.

Keywords: Bowel perforation, Small intestine

I. Introduction

Emergency surgery of the small bowel represents a challenge for the surgeon, in the third millennium as well. There are wide number of pathologies which involve the small bowel with nonspecific clinical presentations and wide range of localized and systemic disorders.^{1,2} Perforation of the small bowel, although uncommon remains a potentially life threatening condition associated with high morbidity and mortality and poorer outcomes especially when the diagnosis is delayed.³⁻⁵

The small intestine is a complex organ with several functions. In fact it is capable of digestion, absorption and secretion, endocrine function and protects the internal environment against noxious ingested substances and against luminal bacteria and their toxins.⁶ The clinical presentation of small bowel perforation may be variable and is related to a multitude of factors, including the source of the perforation and its mechanism, the site and extent of the perforation, time since perforation, the degree of contamination of the peritoneal cavity, and the patient's age and comorbidity burden.⁷

Causes of small bowel perforation are manifold and include trauma and iatrogenic injury, inflammatory conditions, infection, ischemic change, diverticula, foreign bodies, and malignancy. Although some contributing conditions such as traumatic or iatrogenic injury and Crohn's disease are often anticipated, other rare culprits such as an ingested foreign body are commonly unexpected. Another unusual but important cause of small intestinal perforation is tuberculosis. This old disease is a growing concern, particularly in urban areas, because of combined effects of immigration, HIV infection, drug resistance, and rising poverty.⁷

A diverse group of causes of small intestinal perforation have now been recorded in the literature and the list of possible causes is slowly increasing. Once traumatic and some of the more common causes have been

excluded, clinical attention may be focused on other small intestinal disorders, such as CD and GSE, that may be initially presenting with peritonitis and an acute abdomen. Urgent surgical intervention will most often be needed, however, consideration to other rare causes may help in subsequent management, especially if the cause is not immediately apparent during initial urgent diagnostic evaluation or following surgical treatment. Overall, whatever the cause, the rarity of small bowel perforation combined with its propensity for nonspecific clinical presentation makes establishing the correct diagnosis and treatment more challenging.⁷

Small bowel perforation has low mortality and complication rates if it is treated earlier than 24 hours after injury.⁸ In general, despite various causes and delays in diagnosis, resection and primary anastomosis remains an effective treatment for perforation of the small bowel.⁹ Although advances in the treatment and options for small-bowel perforations have occurred, the mortality rate can still be high. During 1980s, studies have reported mortality rate of between 28% and 42%^{9,10} while recent studies have reported mortality rate of 19.1% in 2008.¹¹ In addition, estimates of complications and morbidity post surgery have been as high as 76%.⁹

However the data is scant on the causes and outcome of perforation of the small bowel. The vast majority of published reports are of isolated cases. Also there is minimal analysis of this topic in the literature, especially in Indian settings. This prompted us to analyse causes of small bowel perforation and to assess the mortality and outcome of small bowel associated with the management of small bowel perforations.

2. Aim and objectives:

1. To study the causes of small bowel perforation.
2. To study the mortality and outcome of small bowel perforations.

II. Materials and methods

3.1 Study site:

Rural Development Trust hospital, a 330 bedded secondary level hospital

3.2 Study duration:

January 2014 to December 2014.

3.3 Study design:

The study design was observational prospective study

3.4 Study criteria:

i. Inclusion criteria

- Patients presenting with small bowel perforation during the study period.
- **Exclusion criteria:**
- Patients with duodenal perforations.
- Children below the age of three years.

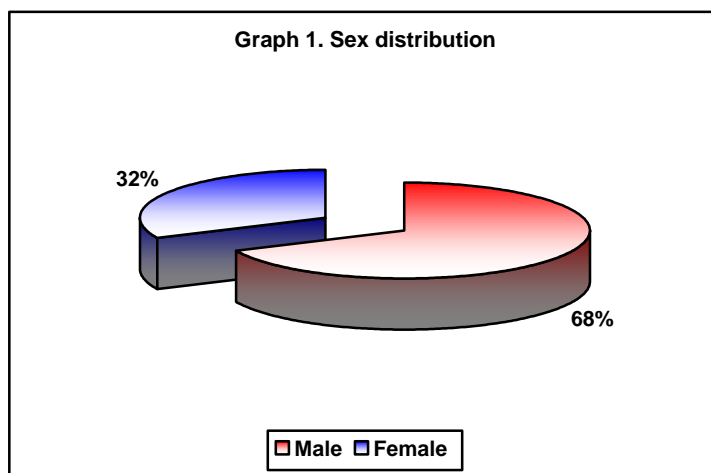
3.5 Statistical analysis:

The data obtained was coded and entered in Microsoft Excel Spreadsheet. The data was analysed using IBM SPSS version 20.0 statistical software. The categorical data was expressed as rates, ratios and percentages and comparison was done using Fisher's exact test. Continuous data was expressed as mean \pm standard deviation. Comparison of categorical data was done using either Chi-square test or Fisher's exact test. A 'p' value of less than or equal to 0.05 at 95% confidence interval was considered as statistically significant.

Results

Table 1. Sex distribution

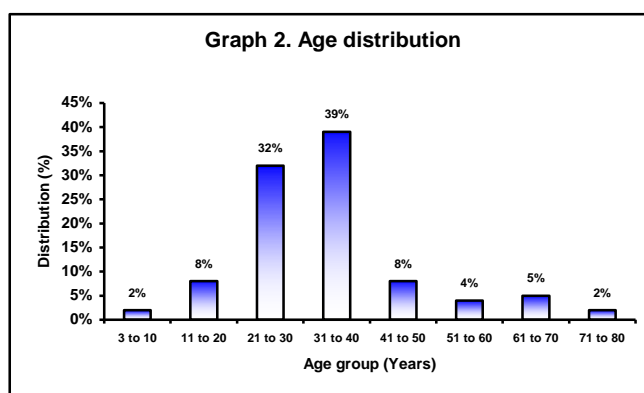
Sex distribution	Distribution (n=100)	
	Number	Percentage
Male	68	68.00
Female	32	32.00
Total	100	100.00



In the present study 68% of the patients were males and 32% were female. The male to female ratio was 2.12:1.

Table 2. Age distribution

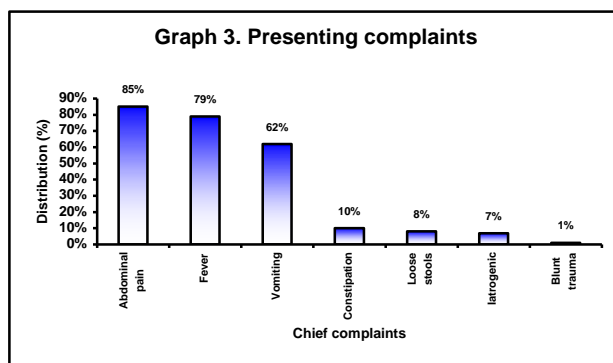
Age group (Years)	Distribution (n=100)	
	Number	Percentage
3 to 10	2	2.00
11 to 20	8	8.00
21 to 30	32	32.00
31 to 40	39	39.00
41 to 50	8	8.00
51 to 60	4	4.00
61 to 70	5	5.00
71 to 80	2	2.00
Total	100	100.00



In this study the commonest age group was 31 to 40 years comprised of 39% of the patients followed by 21 to 30 years (32%). The mean age was 33.97 ± 13.93 years and median age was 32 years and ranged between 9 to 80 years.

Table 3. Presenting complaints

Chief complaints	Distribution (n=100)	
	Number	Percentage
Abdominal Pain	85	85.00
Fever	79	79.00
Vomiting	62	62.00
Constipation	10	10.00
Loose stools	8	8.00
Iatrogenic	7	7.00
Blunt trauma	1	1.00



In the present study abdominal pain was the commonest presenting complaint (85%) followed by fever (79%) and vomiting (62%). However few patients reported constipation (10%), loose stools (8%), iatrogenic (7%) and blunt trauma (1%) also.

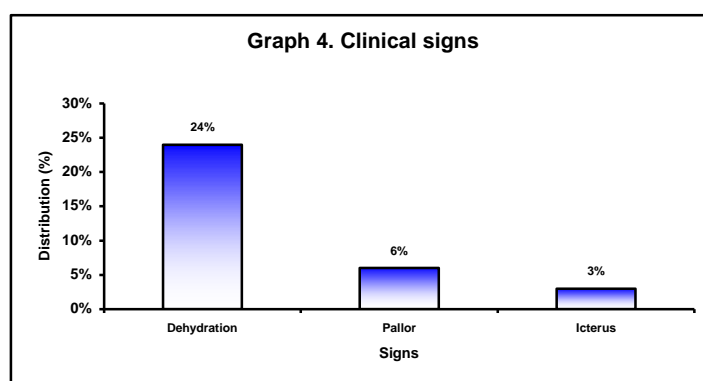
Table 4. Vital parameters

Parameters	Mean (n=100)		Median		
	Mean	SD	Median	Minimum	Maximum
Pulse rate (/Minute)	103.46	13.68	100.00	60.00	134.00
Systolic BP (mm Hg)	109.9	12.99	110.00	80.00	140.00
Diastolic BP (mm Hg)	74.9	9.48	80.00	40.00	90.00
Respiratory rate (/Minute)	23	4.09	22.00	18.00	38.00
Temperature (0F)	100.07	2.41	100.00	90.00	104.00

On clinical examination the mean vitals that is, pulse rate, systolic BP, diastolic BP, respiratory rate and temperature are as shown in table 4.

Table 5. Clinical signs

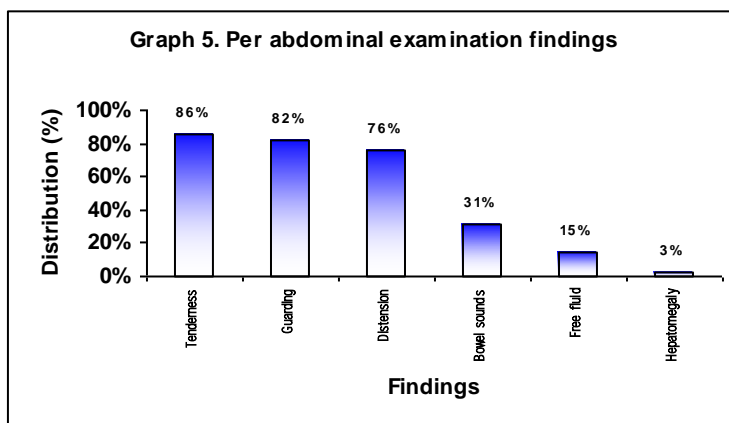
Signs	Distribution (n=100)	
	Number	Percentage
Dehydration	24	24.00
Pallor	6	6.00
Icterus	3	3.00



In this study dehydration was the common clinical sign which was present in 24% of the patients. The other signs noted were pallor and icterus in 6% and 3% respectively.

Table 6. Per abdominal examination findings

Findings	Distribution (n=100)	
	Number	Percentage
Tenderness	86	86.00
Guarding	82	82.00
Distension	76	76.00
Bowel sounds	31	31.00
Free fluid	15	15.00
Hepatomegaly	3	3.00



In the present study, on abdominal examination tenderness was present in 86%, guarding in 82%, distention in 76%, bowel sounds in 31%, free fluid in 15% and hepatomegaly in 3%.

Table 7. Haematological and biochemical profile

Parameters	Mean (n=100)		Median		
	Mean	SD	Median	Minimum	Maximum
Haemoglobin (gm%)	10.95	2.33	10.90	4.80	18.10
Total count (/cumm)	12492	4718.88	12000.00	1600.00	27400.00
Platelet count (/cumm)	93640	74110.77	78000.00	27000.00	330000.00
Blood urea (mg/dL)	35.63	24.28	32.00	10.90	193.00
Serum creatinine (mg/dL)	0.958	0.35	0.95	0.10	2.30
Serum albumin (mg/dL)	3.31	0.67	3.30	1.70	4.80
Serum lactate (mg/dL)	21.46	14.66	18.00	6.00	67.00
Serum sodium (meq/L)	134.46	4.73	135.00	123.00	142.00
Serum potassium (meq/L)	3.748	0.47	3.90	2.55	4.65
Random blood sugar (mg/dL)	111.92	28.59	110.00	74.00	210.00

The biochemical profile of the patients is as depicted in table 7.

Table 8. Peritoneal fluid culture, organisms and sensitivity

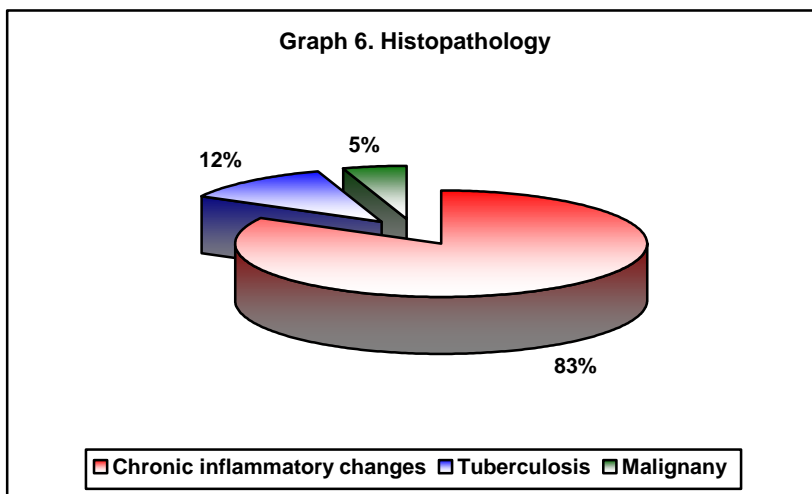
Peritoneal fluid	Findings	Distribution	
		Number	Percentage
Culture (n = 100)	Positive	11	11.00
	Negative	2	2.00
	Not sent	87	87.00
	Total	100	100.00
Organism (n = 11)	Escherichia coli	11	100.00
	ESBL	6	54.55
	Enterococcus fecalis	4	36.36
	Candida	2	18.18
	Providencia	2	18.18
	Staphylococcus	2	18.18
Drugs (n = 11)	Amikacin	7	63.64
	Chloramphenicol	5	45.45
	Ciprofloxacin	4	36.36
	Not sensitive	4	36.36

In the present study peritoneal fluid culture was obtained in 13 cases (13%). Among them, 11 (11%) had positive culture and Escherichia coli was present in all the 11 cases (100%). The other organisms isolated were Enterococcus fecalis (36.36%), candida, Providencia and staphylococcus (18.18% each). Of the 11 culture positive cases, 7 (63.64%) were sensitive and all the organisms were sensitive to Amikacin (63.64%).

Table 9. Histopathology

Findings	Distribution (n=100)	
	Number	Percentage
Chronic inflammatory changes	83	83.00
Tuberculosis	12	12.00

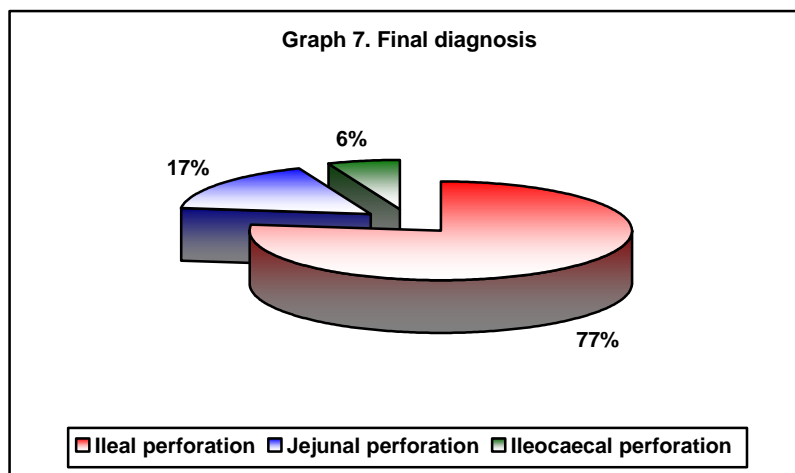
Malignancy	5	5.00
Total	100	100.00



In this study histopathological examination revealed 83% of the patients with chronic inflammatory changes while tuberculosis and malignancy was noted in 12% and 5% of the cases respectively.

Table 10. Final diagnosis

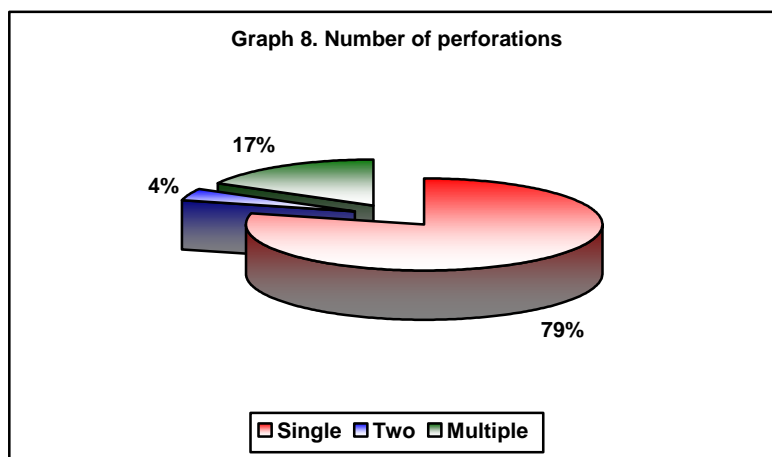
Diagnosis	Distribution (n=100)	
	Number	Percentage
Ileal perforation	77	77.00
Jejunal perforation	17	17.00
Ileocaecal perforation	6	6.00
Total	100	100.00



In the present study majority of the patients had ileal perforation (77%) followed by jejunal perforation (17%) and ileocaecal perforation (6%).

Table 11. Number of perforations

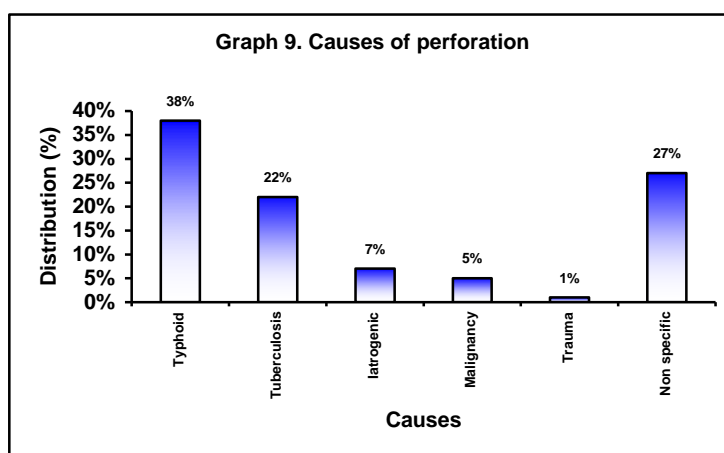
Perforation	Distribution (n=100)	
	Number	Percentage
Single	79	79.00
Two	4	4.00
Multiple	17	17.00
Total	100	100.00



In this study 79% of the patients were found to have single perforation and two perforations were present in 4% while 17% of the patients had multiple perforations.

Table 12. Causes of perforation

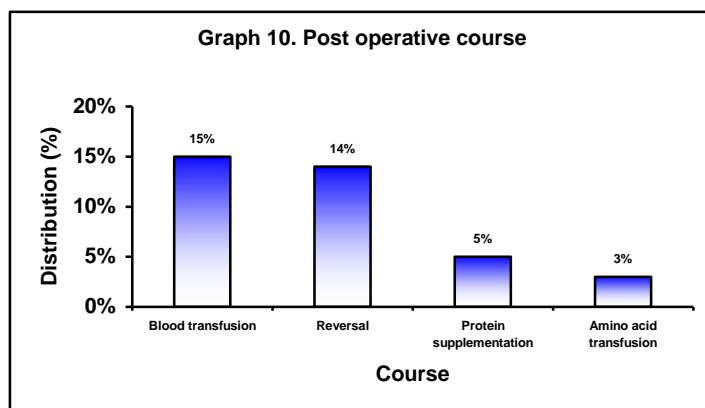
Causes	Distribution (n=100)	
	Number	Percentage
Typhoid	38	38.00
Tuberculosis	22	22.00
Iatrogenic	7	7.00
Malignancy	5	5.00
Trauma	1	1.00
Non specific	27	27.00
Total	100	100.00



In the present study cause of the perforation was typhoid in 38% of the patients and in 22% of the patients tuberculous perforation was noted while non specific causes were noted among 27%.

Table 13. Post operative course

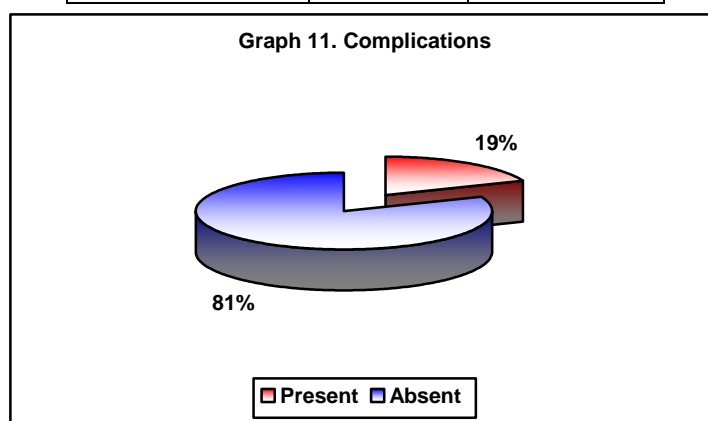
Course	Distribution (n=100)	
	Number	Percentage
Blood transfusion	15	15.00
Reversal	14	14.00
Protein supplementation	5	5.00
Amino acid transfusion	3	3.00



In this study during post operative course blood transfusion was required in 15%, reversal in 14%, protein supplementation in 5% and amino acid transfusion in 3% of the patients.

Table 14. Complications

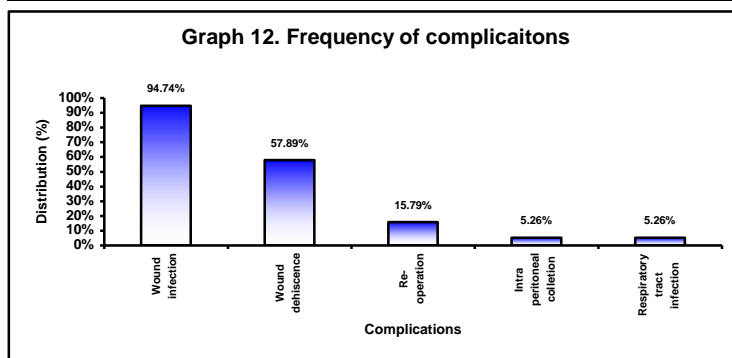
Complications	Distribution (n=100)	
	Number	Percentage
Present	19	19.00
Absent	81	81.00
Total	100	100.00



In the present study complications were present in 19% of the patients.

Table 15. Frequency of complications

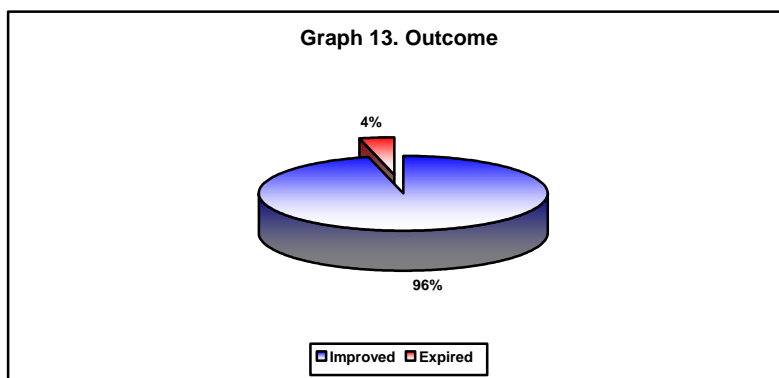
Complications	Distribution (n=19)	
	Number	Percentage
Wound infection	18	94.74
Wound dehiscence	11	57.89
Re-operation	3	15.79
Intra peritoneal collection	1	5.26
Respiratory tract infection	1	5.26



In this study among the 19 patients with complications, 94.74% had wound infection, 57.89% had wound dehiscence, 15.79% had reoperation and 5.26% each had intraperitoneal collection and respiratory tract infection.

Table 16. Outcome

Outcome	Distribution (n=100)	
	Number	Percentage
Improved	96	96.00
Expired	4	4.00
Total	100	100.00



In the present study 96% of the patients improved and 4% expired.

Table 17. Association of sex with of causes, site of perforation, complications and outcome

Variables	Sub-groups	Sex				'p' value
		Male		Female		
		No	%	No	%	
Causes	Typhoid	29	76.32	9	23.68	0.504
	Tuberculosis	12	54.55	10	45.45	
	Malignancy	3	60.00	2	40.00	
	Iatrogenic	4	57.14	3	42.86	
	Trauma	1	100.00	0	0.00	
	Non specific	19	70.37	8	29.63	
	Total	68	68.00	32	32.00	
Site	Ileal	52	67.53	25	32.47	1.000
	Ileocaecal	4	66.67	2	33.33	
	Jejunal	12	70.59	5	29.41	
	Total	68	68.00	32	32.00	
Complications	Present	13	19.12	6	18.75	0.965
	Absent	55	80.88	26	81.25	
	Total	68	68.00	32	32.00	
Outcome	Improved	65	95.59	31	96.88	0.617
	Expired	3	4.41	1	3.13	
	Total	68	68.00	32	32.00	

The association of sex with causes, site of perforation, complications and outcome are as shown in table 17 and no statistically significant association was found ($p > 0.050$).

Table 18. Association of age with causes, site of perforation, complications and outcome

Variables	Causes	Age group (Years)									
		< 18		19 to 30		31 to 45		46 to 60		> 60	
		No	%	No	%	No	%	No	%	No	%
Causes	Typhoid	5	13.16	12	31.58	17	44.74	2	5.26	2	5.26
	Tuberculosis	4	18.18	8	36.36	7	31.82	3	13.64	0	0.00
	Malignancy	0	0.00	0	0.00	4	80.00	1	20.00	0	0.00
	Iatrogenic	0	0.00	0	0.00	2	28.57	3	42.86	2	28.57
	Trauma	0	0.00	0	0.00	0	0.00	1	100.00	0	0.00
	Non specific	1	3.70	12	44.44	11	40.74	0	0.00	3	11.11
	Total	10	10.00	32	32.00	41	41.00	10	10.00	7	7.00
											p=0.004
Site	Ileal	10	100.00	28	87.50	28	68.29	8	80.00	3	42.86
	Ileocaecal	0	0.00	0	0.00	4	9.76	0	0.00	2	28.57
	Jejunal	0	0.00	4	12.50	9	21.95	2	20.00	2	28.57
	Total	10	10.00	32	32.00	41	41.00	10	10.00	7	7.00

											p=0.052
Complications	Present	3	30.00	4	12.50	7	17.07	3	30.00	2	28.57
	Absent	7	70.00	28	87.50	34	82.93	7	70.00	5	71.43
	Total	10	10.00	32	32.00	41	41.00	10	10.00	7	7.00
											p=0.451
Outcome	Improved	9	90.00	32	100.00	40	97.56	8	80.00	7	100.00
	Expired	1	10.00	0	0.00	1	2.44	2	20.00	0	0.00
	Total	10	10.00	32	32.00	41	41.00	10	10.00	7	7.00
											p=0.053

In the present study age was significantly associated with causes of perforation (p=0.004) but not associated with site of perforation, complications and outcome.

Table 19. Association of causes with site of perforation

Causes	Site					
	Ileal		Ileocaecal		Jejunal	
	No	%	No	%	No	%
Typhoid	31	81.58	2	5.26	5	13.16
Tuberculosis	16	72.73	2	9.09	4	18.18
Malignancy	5	100.00	0	0.00	0	0.00
Iatrogenic	7	100.00	0	0.00	0	0.00
Trauma	0	0.00	0	0.00	1	100.00
Non specific	18	66.67	2	7.41	7	25.93
Total	77	77.00	6	6.00	17	17.00

p=0.473

In this study no statistically significant association was found between causes and site of perforation (p=0.473).

Table 20. Association of complications with of site of perforation

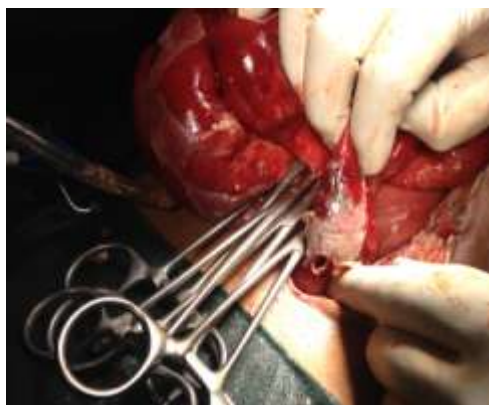
Variables	Sub-groups	Complications				'p' value
		Present		Absent		
		No	%	No	%	
Causes	Typhoid	7	18.42	31	81.58	0.209
	Tuberculosis	5	22.73	17	77.27	
	Malignancy	3	60.00	2	40.00	
	Iatrogenic	0	0.00	7	100.00	
	Trauma	0	0.00	1	100.00	
	Non specific	4	14.81	23	85.19	
	Total	19	19.00	81	81.00	
Site	Ileal	11	14.29	66	85.71	<0.001
	Ileocaecal	6	100.00	0	0.00	
	Jejunal	2	11.76	15	88.24	
	Total	19	19.00	81	81.00	

In the present study all the patients with ileocaecal perforation had complications (100%) compared to 14.29% with ileal perforation and 11.76% with jejunal perforation. This difference was statistically significant (p<0.001). However the complications were not association with the causes of perforation (p=0.209).

Table 21. Association of outcome with causes and site of perforation

Variables	Sub-groups	Outcome				'p' value
		Improved		Expired		
		No	%	No	%	
Causes	Typhoid	38	100.00	0	0.00	0.178
	Tuberculosis	20	90.91	2	9.09	
	Malignancy	5	100.00	0	0.00	
	Iatrogenic	6	85.71	1	14.29	
	Trauma	1	100.00	0	0.00	
	Non specific	26	96.30	1	3.70	
	Total	96	96.00	4	4.00	
Site	Ileal	75	97.40	2	2.60	0.226
	Ileocaecal	6	100.00	0	0.00	
	Jejunal	15	88.24	2	11.76	
	Total	96	96.00	4	4.00	

In this study outcome was significantly not associated with causes and sites of perforation (p>0.050).



Photograph 1. Ileal perforation



Photograph 2. Jejunal perforation



Photograph 3. Resected ileal segment with multiple perforations photograph 4. Resected part of jejunum



Photograph 5. Wound infection with dehiscence

III. Discussion

The wide diversity of etiologies of spontaneous small intestinal perforation and the rarity of this condition make it unlikely for any one surgeon or institution to amass an extensive experience in managing these patients. Further nonspecific clinical picture manifested by these patients, preoperative diagnosis is usually not possible. Therefore, the general surgeon performing exploratory laparotomy on a patient with peritonitis must be aware of the diverse etiologies of perforation, the unique characteristics of each, and their management.¹⁵ However there is lack of data exploring the causes and outcome of perforation of the small bowel and is limited to isolated case reports. This study was an attempt to find out the common causes of small bowel perforation and outcome.

The present one year prospective observational study was carried out from January 2014 to December 2014 on a total of 100 patients who presented with small bowel perforation at the Department of General and Minimal Access Surgery, Rural Development Trust Hospital, Bathalapalli. Patients were evaluated for the causes of small bowel perforation based on various investigations and clinical presentation and the outcome was determined based on the morbidity and mortality.

Demographic characteristics

In the present study nearly two third of the patients (68%) were males with male to female ratio of 2.12:1 suggesting male preponderance. Most of the patients with presented in fourth decade of life with age 31 to 40 years (39%) followed by third decade that is, 21 to 30 years (32%). The mean and median age was 33.97 ± 13.93 years and 32 years respectively with youngest patient being nine year old and older being 80 years. Overall these findings suggest that, the frequency of small bowel perforation is high among males and are common in third and fourth decade of life. Recently, Allsopp T. et al.⁸³ investigated the causative factors and outcomes of 32 patients with a small-bowel perforation and reported that, age of the total population cohort studied ranged from 8-92 years with a median age of 44.5 years. The age range in the present study was comparable with the study by Allsopp T. et al.⁸³ However, mean age observed in the present study was low compared to latter study which could explained by the larger sample size of the study population compared to the study by Allsopp T. et al.⁸³

Clinical presentation

In this study majority of the patients presented with abdominal pain (85%). The next common compliant was fever (79%) and vomiting (62%). The other complaints were noted as constipation (10%), loose stools (8%), blunt trauma (7%) and iatrogenic (1%). On clinical examination, dehydration was the common clinical sign (24%). The abdominal examination, tenderness, guarding and distension were the common features present among 86%, 82% and 76% respectively.

Etiology of small bowel perforation

Small-bowel perforation is a rare event that results from a number of different etiological causes. Causes include, trauma, infection, inflammatory bowel disease, foreign body ingestion, malignancy, iatrogenic causes and medical therapies for other diseases.^{10,11}

In the present study peritoneal fluid culture done among 13 patients cases, of which 11 (11%) had positive culture and *Escherichia coli* was present in all the 11 cases (100%) being the commonest organism. On histopathological examination, majority of the patients had (83%) chronic inflammatory changes followed by tuberculosis (12%) and malignancy (5%). With regard to site of perforation, more than three fourth of the study population had ileal perforation (77%) and in the remaining jejunal perforation (17%) and ileocaecal perforation (6%) were seen. Majority of the patients had single perforation (79%) while two and multiple perforations were present in 4% and 17% of the patients respectively. Based on these features, the commonest cause of perforation was typhoid which was present in 38% of the patients. The other causes noted were tuberculous perforation (22%), Iatrogenic (7%), malignancy (5%), trauma (1%) and more than one fourth that is 27% of the patients had non specific causes. These propose higher frequency of non traumatic causes of small bowel perforation with typhoid and tuberculous perforation being the commonest etiology. Further statistically significant association was found between causes of the perforation with the age of the patient ($p=0.004$) suggesting strong relationship between age and cause of the perforation.

Recently, Allsopp T. et al.⁸³ investigated the causative factors and outcomes of patients with a small-bowel perforation treated at a rural hospital retrospectively. The largest causative mechanism of small-bowel perforation was non-surgical trauma ($n=8$, 25%) followed by ischaemia caused by vascular insufficiency secondary to adhesions ($n=6$, 18.8%). Other causative mechanisms included, iatrogenic injury ($n=4$, 12.5%), small bowel diverticula ($n=3$, 9.4%), carcinoma ($n=2$, 6.3%), adhesions ($n=2$, 6.3%), perforation of a Meckel's Diverticulum ($n=2$, 6.3%) and ingested foreign bodies ($n=2$, 6.3%).

Different pathologies may lead to perforation of the small intestine. Infection is the commonest cause of such perforations in developing countries. This includes typhoid fever and tuberculosis.^{4,84-87} Nevertheless, in industrial countries, non-infectious etiology such as Crohn's disease and malignancy is predominant. Rare cases of non-traumatic perforation of small intestine due to opportunistic infections were also reported.^{4,85}

Typhoid is the commonest cause of ileal perforation in our country,⁸⁵ which was true in the present study. The higher rate of typhoid perforation observed in this study could be explained the public health burden of enteric fever in India is huge. Population based studies from urban population in India suggest that incidence of typhoid fever is 2730 per 100,000 populations per year in 0-4 year old children, 1170 per 100,000 per year in 5-19 year age group and 110 per 100 000 per year in 20-40 year age group.⁸⁸

World-wide, typhoid fever undoubtedly represents the most common cause of small intestinal perforation.¹⁵ Earlier, in two large series of patients with typhoid fever, perforation occurred in 78 of 1470 patients (5.3%), and 141 of 789 patients (17.9%).^{89,90} Typhoid Ileal perforation is still seen with higher incidence amongst males.⁹¹ In the present study also of the 38 cases with small bowel perforation due to typhoid, majority were males (76.32%) and seen most of the adults with middle age (44.74% between 31 to 45 years) and young adults (31.58% between 19 to 30 years). These findings were consistent with a study Singh G. et al.⁸⁸ from Pune Maharashtra who reported mean age of patients as 29.36 years and to an earlier report.⁹¹ In the

present study the common site of typhoid perforation was ileum (81.58%). This could be explained by the male preponderance observed in the study as higher incidence of typhoid ileal perforation is seen amongst males.⁹¹

In the present study the second common etiology of small bowel perforation was tuberculosis. Abdominal tuberculosis (TB) is the sixth most frequent extra-pulmonary location and it is relatively rare in the industrialized world. It is a disease that predominantly affects young adults. Two-thirds of all cases involve patients between 21 and 40 years of age. There is no difference in the incidence rate between male and female subjects, although some studies suggest a slightly increased female predisposition.³⁹ The same was true in the present study as of the 22 cases with tuberculous small bowel perforation, 36.36% of the patients were aged 19 to 30 years and 31.82% were aged between 31 to 45 years. Also with regard to sex predilection, 54.55% were males and 45.45% were females. With regard to site of perforation, majority of the cases had ileal perforations (72.73%) which was consistent with a recent study by Coccolini F. et al.³⁹ from USA.

In the present study malignancy as cause of small bowel perforation was noted in five cases. Of these, three cases (60%) were males and noted among four middle aged cases (80%). Although the small bowel comprises three quarters of the length of the gastrointestinal tract, malignant tumors of the small bowel comprise less than 1% of all gastrointestinal malignancies. The different pathologic types of small bowel malignant tumors include adenocarcinoma, carcinoid tumors, leiomyosarcoma, and lymphoma. Adenocarcinoma is the most commonly encountered small bowel malignant tumor.⁹²

In this study one case (1%) of traumatic small bowel perforation was noted. Blunt abdominal trauma can cause bowel perforation by means of deceleration shear, and high-speed motor vehicle crash is one of the most common deceleration mechanisms. Small bowel is typically compressed against a fixed point, usually the vertebral column. This rapid increase in intraluminal pressure leads to perforation of the bowel wall at the antimesenteric border, where the bowel is usually weaker. Lap-only seat belts, commonly used in most cars until the 1980s, were largely held responsible for SBP.⁹³

In the present study more than one fourth (27%) cases were regarded as non specific small bowel perforation. A “non-specific” etiology is attributed to small bowel perforations when the perforation cannot be classified on the basis of clinical symptoms, gross examination, serology, culture and histopathological examination into any disease state such as enteric fever, tuberculosis or malignancy. These ulcers are usually single and commonly involve terminal ileum. It has been proposed that submucous vascular embolism, chronic ischemia due to atheromatous vascular disease or arteritis, or drugs such as enteric coated potassium tablets are responsible for them. Apart from enteric fever and “non-specific” ulcers other causes in western countries include Crohn's disease, Behcet's disease, radiation enteritis, adhesions, ischemic enteritis, SLE and very rarely intestinal tuberculosis.⁸⁸

Post operative course and complications

In this study post operatively 15% of the patients required blood transfusion and reversal was indicated among 14% of the patients while protein supplementation and amino acid transfusion was required among 5% and 3% of the patients respectively. The frequency of complications was 19%. Among the 19 patients with complications, 18 (94.74%) patients had wound infection, 11 (57.89%) had wound dehiscence, three (15.79%) had reoperation and one patient each (5.26% each) had intraperitoneal collection and respiratory tract infection. The complications were significantly high in patients with ileocaecal perforation that is, all the patients with ileocaecal perforation had complications (100%) compared to 14.29% with ileal perforation and 11.76% with jejunal perforation ($p < 0.001$). There is very little scientific evidence with regard to the complications of small bowel perforation. Estimates of complications and morbidity post surgery have been as high as 76%.¹⁰ A study by Singh G. et al.⁸⁸ found wound infection and residual abscess as complications in one patient each. Larger series from literature show wound infection in 68%, incisional hernia in 36% wound dehiscence in 27%, enterocutaneous fistulae in 13% and intraabdominal abscess in 9% patients.^{94,95} Compared to these studies^{10,88,94,95} the rate of complications was low in the present study.

Outcome

Although advances in the treatment and options for small-bowel perforations have occurred, the mortality rate can still be high. Intestinal perforation is associated with high mortality if early and proper management is not initiated. Preoperative resuscitation and intravenous antibiotic are important. Furthermore, the general condition of the patient, the number of perforations, the condition of the intestine, and surgeon's experience define the operative procedure, prognosis and outcome.⁹⁶ In this study 96% of the patients improved and mortality was noted 4% of the patients. Orringer et al.¹⁰ and others⁹ report a mortality rate of between 28% and 42% during the 1980s while Kan Tan et al.¹¹ report a mortality rate of 19.1% in 2008. The lower rate of complications and mortality compared to other studies⁹⁻¹¹ would be possibly due to the prompt diagnosis and early management which is the gold standard.

Overall, to conclude, a diverse group of causes of small intestinal perforation have now been recorded in the literature and the list of possible causes is slowly increasing. Once traumatic and some of the more

common causes have been excluded, clinical attention may be focused on other small intestinal disorders, such as CD and GSE, that may be initially presenting with peritonitis and an acute abdomen. Urgent surgical intervention will most often be needed, however, consideration to other rare causes may help in subsequent management, especially if the cause is not immediately apparent during initial urgent diagnostic evaluation or following surgical treatment.

IV. Conclusion

The present study showed that frequency of small bowel perforation is high among males and peak during third and fourth decade of life. Non traumatic small bowel perforations are widely prevalent with infectious etiology that is, typhoid and tuberculosis. There is considerable subset of patients who present of non specific causes of small bowel perforation which pose challenge to the treating surgeon to diagnose and manage. Small bowel perforations are rare due to malignancy and iatrogenic causes. Timely diagnosis and prompt management is the gold standard for the favourable outcome in patients with small bowel perforation.

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