

A prospective study on small bowel perforation, its etiopathological correlations

¹Dr. Rohit Kapoor, (M.S. General Surgery), Senior Clinical Fellow, Department of General Surgery, Barking Havering and Redbridge university hospitals, Romford London, United Kingdom.

²Dr. Safarudeen Sapharullah, Postgraduate Resident, Department of General Surgery, Maharishi Markandeshwar Institute of Medical Sciences & Research, Mullana, India.

³Dr. Shubh Kirti, (M.D.S. Periodontology), Associate Professor, Department of Periodontology, Maharishi Markandeshwar College of Dental Sciences & Research, Mullana, India.

⁴Dr Mayank Chaudhary, Post- graduate Resident, Department of General Surgery, Maharishi Markandeshwar Institute of Medical Sciences & Research, Mullana, India.

Corresponding Author: Dr. Rohit Kapoor, (M.S. General Surgery), Senior Clinical Fellow, Department of General Surgery, Barking Havering and Redbridge university hospitals, Romford London, United Kingdom.

Citation this Article: Dr. Rohit Kapoor, Dr. Safarudeen Sapharullah, Dr. Shubh Kirti, Dr Mayank Chaudhary, “A prospective study on small bowel perforation, its etiopathological correlations”, IJMSIR- June - 2023, Vol – 8, Issue - 3, P. No. 300 – 315

Type of Publication: Original Research Article

Conflicts of Interest: Nil

Abstract

Objective: To study the Etiopathological correlation of small bowel perforation in our institution.

Material and Methods: This study was conducted for a period of 18 months from March 2021 to August 2022. After clearance from institutional ethical committee, 30 cases of Small Bowel perforations were studied during this period. The provisional diagnosis was made preoperatively and confirmed intraoperatively, and data was collected. Factors were tabulated and statistically analysed to study their contributions.

Results: From this study, most common cause for small bowel perforation was typhoid ileal perforation accounting for 43.3% cases. They also showed male predominance with sex ratio of 2.75:1. Maximum number of cases were found in 41-50 age group, which constitutes 23.3% patient. Most common site of small

intestine perforation in this present study was ileum constituting 66%. The time interval between admission and surgical intervention had been studied and showed that 80 % got operated within 10 hours. In the present study histopathological findings of 17(60%) cases did not correlate with any etiological diagnosis.

Conclusion: The most common cause of small intestinal perforation is typhoid ileal perforation. Most of the patient present in the 4th and 6th decade of life and there is male predominance. Perforation site, organism involved, timing of presentation has impact on mortality. Perforation edge biopsy is not diagnostic in all small bowel perforations.

Keywords: Male Predominance, Edge Biopsy, Ileum, Typhoid, Small Bowel Perforation

Introduction

Perforation is defined as an abnormal opening in a hollow organ or viscus. It is derived from the Latin perforatus, meaning “to bore through.”¹ The spectrum of etiology of perforation is different between developing and developed countries and there is a paucity of data from India regarding its etiology, prognostic indicators, morbidity, and mortality patterns. Gastrointestinal perforation is one of the most common causes for acute abdominal emergency in the surgical field. Clinical presentation of GI (gastrointestinal) perforation may vary from severe abdominal pain to mild or no symptoms in the hospitalized patient for unrelated illness. So, this is really challenging task to the emergency surgeon to diagnose GI perforation.

Small bowel perforation is the most common surgical emergency in India¹. Surgeons operating on cases of peritonitis should be aware of various possibilities of small bowel perforation as majority of them are due to perforation of the small bowel. The spectrum varies much from the west. The mortality due to small bowel perforation continues to be high ranging from 11.5% to 37% in various studies². So prompt diagnosis is extremely vital in these situations.

In GIT (gastrointestinal tract) perforation, there is disruption in the wall of GIT, which can be caused by blunt injury, penetrative injury, iatrogenic, inflammatory causes penetrating serosal and adventitious layer and tumors invading GI viscera.

In duodenum one of the most common causes for perforation is peptic ulcer perforation. But this cause has been drastically decreased due to introduction of medical treatment by H₂(hydrogen) receptor antagonist and Protein pump inhibitors. However, the complications like perforation and bleeding which needs emergency surgery is relatively constant, because of the risk factors like

smoking, alcohol and NSAIDS (non-steroidal anti-inflammatory drugs).

In this study the most common cause of ileal perforations in developing countries like India is typhoid fever, which is more common in lower socioeconomic status group, because of improper sanitation and drainage system. Tubercular ileal perforation is one of the causes of small bowel perforation in India.

Jejunum is the least common site of small intestinal perforation and is mostly caused by blunt abdominal trauma. The main disadvantage of jejunal perforation is, it has a late presentation most commonly 3-4 days after injury which adds to the morbidity and mortality of jejunal perforation.

As per a study the most common cause was typhoid followed by tubercular perforation and traumatic perforation. Same study also concluded that most common site is duodenal>ileal>jejunal.¹

An observational prospective study conducted on pattern and etiology of patient with gastrointestinal perforation showed that most common cause was peptic ulcer disease followed by enteric fever and tuberculosis and the most common site of perforation was gastroduodenal followed by terminal ileum³

Another study was conducted in 90 patients of non-traumatic small bowel perforation concluded that most common etiology of non-traumatic small bowel perforation was found to be typhoid perforation (56.66%) followed by peptic ulcer disease (27.77%), intestinal tuberculosis (10%) and non-specific causes (5.5%)⁴. So from these studies we can understand that etiology and sites of small bowel perforation shows wide geographical variation in our country.⁵

Small bowel perforations continue to be a great challenge for surgeon's despite of the better understanding of pathophysiology, advances in diagnosis, surgery,

antimicrobial therapy, and intensive care support. Hence it becomes mandatory for us to have in-depth knowledge of their numerous etiologies, presentations, and management.

Materials And Methods

Source of Data: This study was conducted at teaching hospital affiliated to author's medical college for a period of 18 months from March 2021 to August 2022. After clearance from institutional ethical committee, 30 cases of Small Bowel perforations were studied during this period. The Provisional diagnosis was established in the Emergency room based on the clinical presentation and supporting radiological evidence. Definitive diagnosis was established at the time of surgery. Operative details were included in the study were site of the perforation, size of the perforation, nature and quantity of peritoneal soiling, time interval between the hospital admission and surgery, nature of operation performed, Peritoneal fluid culture and Perforation edge biopsies were performed for histologic pathological examination. All Cases of Esophageal, Gastric, Large bowel and Appendicular perforations were excluded from the study. Factors were tabulated and statistically analyzed to study their contributions.

Type of Study: Prospective study.

Sample Size: This is the study, which was carried out on 30 patients aged 18 years and above.

Study Duration: 18-months

Inclusion Criteria: All the patients above 18 years clinically diagnosed as small bowel perforation were included in this study.

Exclusion Criteria

1. Esophageal perforation
2. Gastric perforation
3. Large bowel perforation
4. Appendicular perforation

5. Refusal for consent

Parameters Studied: Data was collected based on patient's age, gender, clinical signs and symptoms, Operative details collected in the study were site of the perforation, size of the perforation, nature and quantity of peritoneal soiling, time interval between the hospital admission and surgery, the nature of operation performed, Peritoneal fluid culture and Perforation edge biopsies for histologic pathological examination.

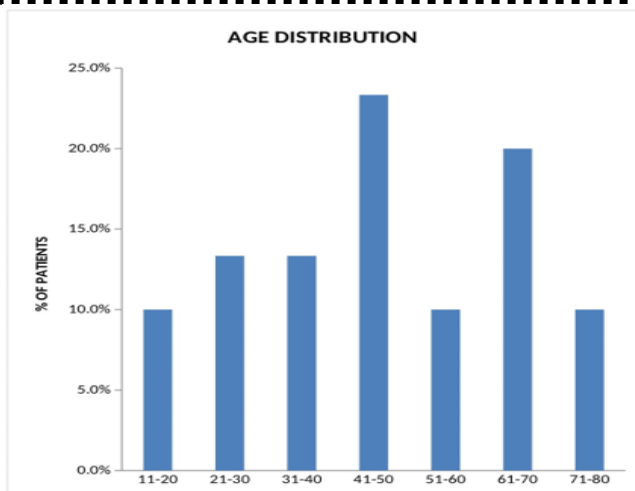
Ethical Considerations: This was a prospective study and was done after taking proper Informed consent from the patient and relatives.

Results

The present study was conducted on 30 patients with the diagnosis of small bowel perforation admitted in teaching hospital affiliated to author's medical college.

Table 1: Age Distribution

Age Distribution	Frequency	Percent
11-20	3	10.0%
21-30	4	13.3%
31-40	4	13.3%
41-50	7	23.3%
51-60	3	10.0%
61-70	6	20.0%
71-80	3	10.0%
Total	30	100.0%

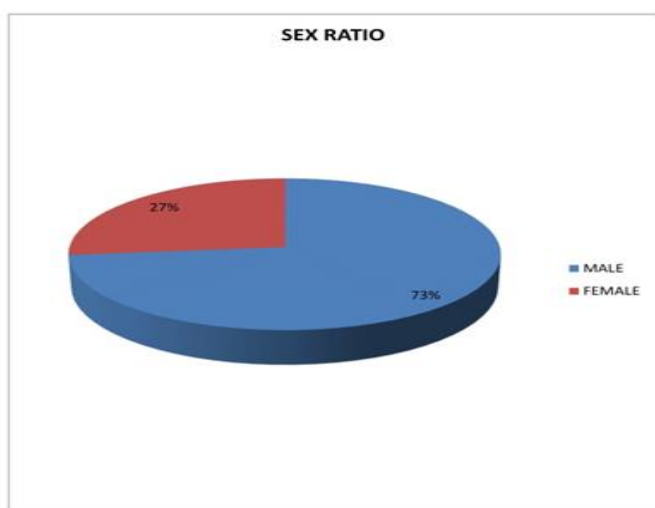


Graph 1: Age Distribution

Table 1 and Graph 1 show that, 23.3% cases presented in 4th decade and 20% presented in 6th decade of their life. 13.3% cases presented in 2nd and 3rd decade. Here if we observe the distribution of the cases, it can be seen that, as age increases, the chances of patient presenting with small intestine perforation is also increasing.

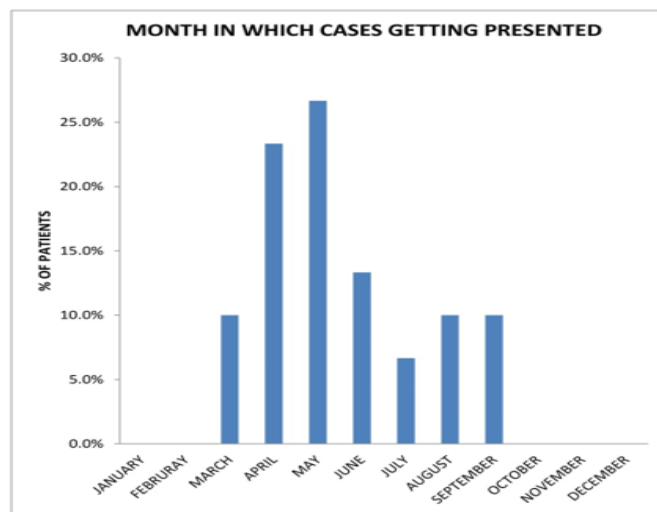
Table 2: Sex Ratio

sex ratio	Frequency	Percent
Male	22	73.3%
Female	8	26.7%
Total	30	100.0%



Graph 2 : Sex Ratio

Table 2 and Graph 2 depicts the sex ratio in this study. In total of 30 small bowel perforation cases, 73.3% patients were male and 26.7% were female. This shows that small intestinal perforation has male predominance.



Graph 3 : Month in which cases getting presented

Graph 3 depicts, the months when the small bowel perforation cases were getting presented. In this series, cases started presenting from the month of March to September. More number of cases were recorded in May which is around 26.7%. Second comes the month of April that is 23.3%.

Table 3: time interval between admission and intervention

Time interval between Admission and intervention	Frequency	Percent
2-4	10	33.3%
4-6	10	33.3%
6-8	1	3.3%
8-10	3	10.0%
>10	6	20.0%
Total	30	100.0%

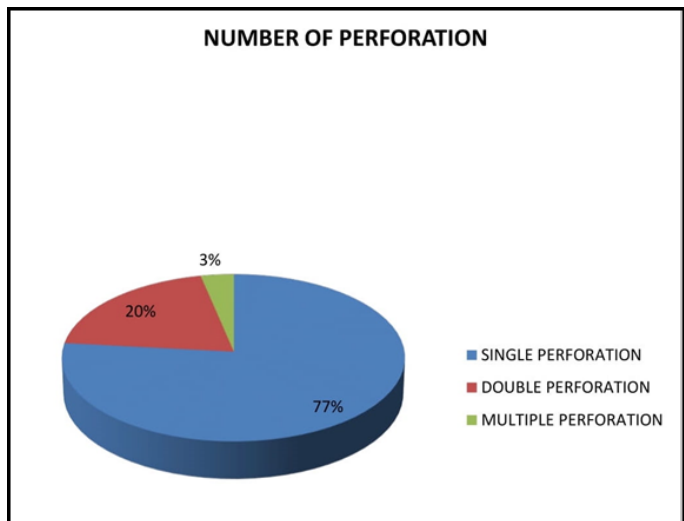
Table 3 shows the time interval between the admission and the surgical intervention. 33.3% (10 cases) cases got operated within 4 hours and another 33.3% case got

operated within 4 to 6 hours. Nearly 20% patient got operated after 10hours. In this study nearly 80% cases got operated within 10 hours.

Table 4: site of perforation

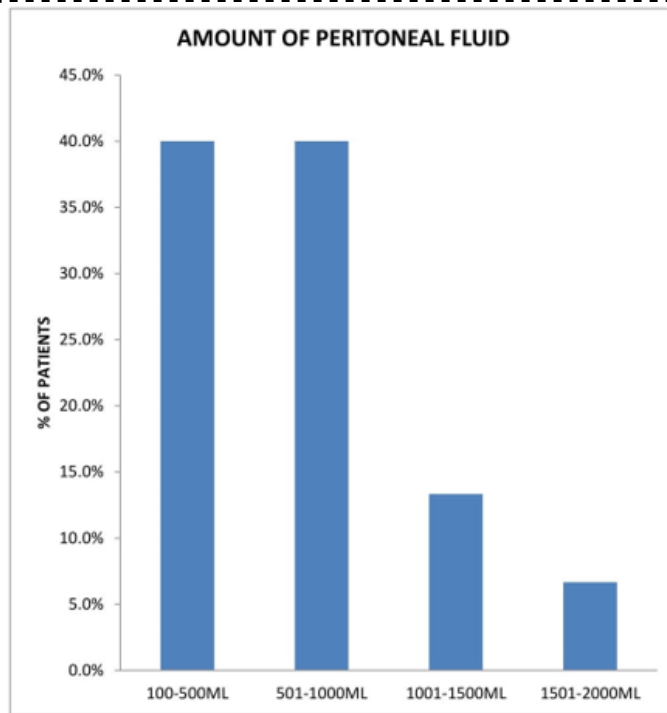
Site of perforation	Frequency	Percent
Duodenum	6	20.0%
Jejunum	4	13.3%
Ileum	20	66.7%
Total	30	100.0%

Table 4 shows site of perforation. Most common site of perforation is ileum. Around 66.6% patients had ileal perforation. Second comes the duodenum, that is around 20% (6 cases). Only 13.3% patient had jejunal perforation.



Graph 4: Number of Perforation

Graph 4 describes the number of perforations in a single patient. It has been observed that 76.7% patients had single perforation. 20% patients had double perforation. Only one patient had multiple perforation.



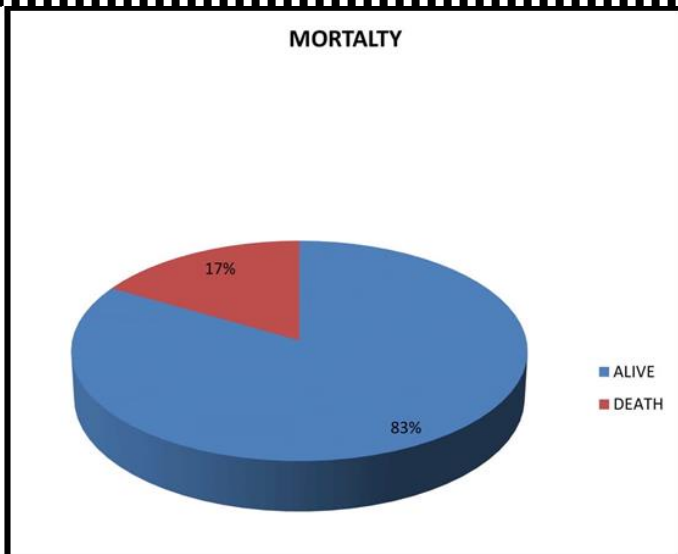
Graph 5: Amount of peritoneal fluid

Graph 5 depicts the amount of peritoneal fluid 40% patients had less than 500 ml peritoneal fluid drained intraperitoneally. Another 40% patients had 500 to 1000ml peritoneal fluid drained. 13.3% patients had 1000 to 1500 ml peritoneal fluid and 6.7% patients had 1500 to 2000 ml peritoneal fluid drained.

Table 5: nature of peritoneal fluid

Nature of peritoneal fluid	Frequency	Percent
Faeculent & purulent	17	56.7%
Bilious and pus flakes	3	10.0%
Bilious	4	13.3%
Purulent with pus flakes	5	16.7%
Hemorrhagic	1	3.3%
Total	30	100.0%

Table 5 shows the nature of peritoneal fluid. 56.7% had faeculent and purulent peritoneal fluid. 16.7% patient had purulent with pus flakes peritoneal fluid. 13.3% patient had bilious and 10% had bilious with pus flakes peritoneal fluid. Patient who had traumatic jejunal perforation had hemorrhagic peritoneal fluid.



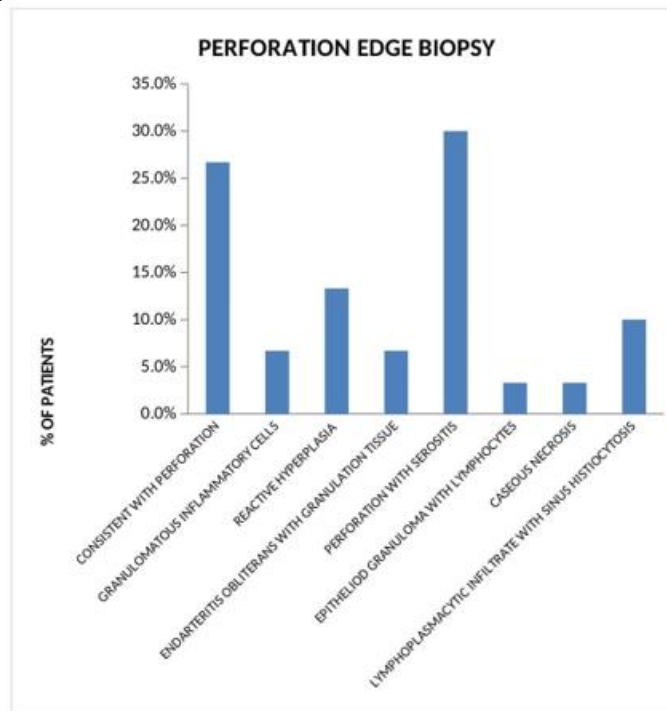
Graph 6: Mortalty

Graph 6 shows that 16.7% patient i.e., 5 out of 30 patients died of small bowel perforation despite surgical intervention. In this study 83.3% patient survived.

Table 6: Etiology of Small Bowel Perforation

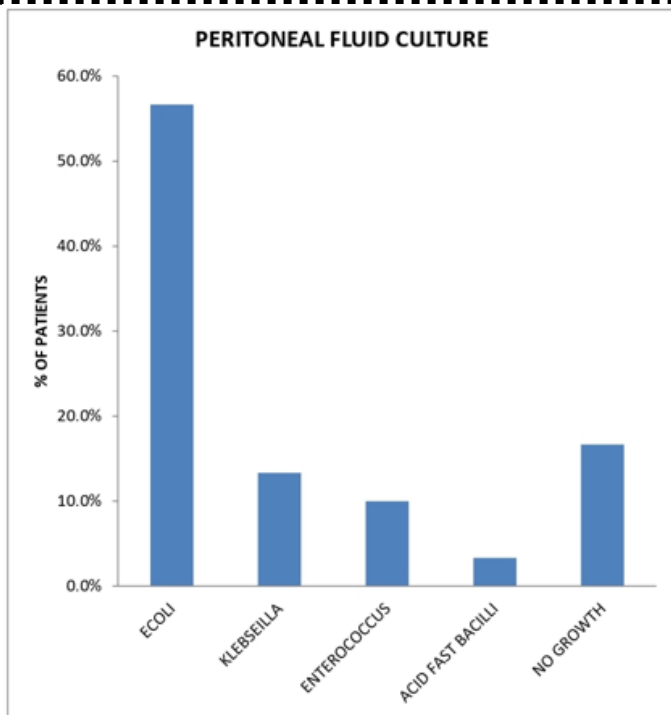
Etiology Of Small Bowel Perforation	Frequency	Percent
Typhoid	13	43.3%
Tuberculosis	7	23.3%
Non-Specific	4	13.3%
Peptic Ulcer	3	10.0%
Jejunal Diverticulae	1	3.3%
Malignancy	1	3.3%
Trauma	1	3.3%
Total	30	100.0%

Table 6 studies the etiology of small bowel perforation. 43.3% patient typhoid perforation. 23.3% showed tubercular etiology. 10% patient had peptic ulcer perforation. 13.3% patient showed nonspecific ulceration. Other etiologies were jejunal diverticula, ovarian malignancy, and trauma.



Graph 7: Perforation Edge Biopsy

Graph 7 depicts the perforation edge biopsy of the small bowel perforation cases. Most common histopathological finding in the preset study was “PERFORATION WITH SEROSITIS” and 2nd most common finding was “CONSISTENT WITH PERFORATION”. Histopathological finding which correlated with typhoid ileal perforations are REACTIVE HYPERPLASIA (13.3%), LYMPHOPLASMACYTIC INFILTRATE WITH SINUS HISTIOCYTOSIS (10%). Findings which favored tuberculosis were GRANULOMATOUS INFLAMMATORY CELL (6.7%), CASEOUS NECROSIS (3.3%) AND EPITHELIOD GRANULOMA WITH LYMPHOCYTES (3.3%). 2 cases of peptic ulcer perforation of duodenum showed ENDARTERITIS OBLITERANS WITH GRANULATION TISSUES.



Graph 8: Peritoneal Fluid Culture

Graph 8 shows that peritoneal fluid culture of 56.7% cases were positive for E coli. Klebsiella was seen in 13.3% cases. 10% of peritoneal fluid culture showed enterococcus in the culture and one patient had acid fast bacilli in the culture. Around 5 patient culture report came as no growth.

Discussion

Etiopathogenesis of Perforation In Peptic Ulcer

1. NSAIDS

They interfere with cyclooxygenase pathway which leads to production of prostanoids. These prostanoids affects the gastric mucosal barrier by reducing the effectiveness of mucus bicarbonate barrier. They are independent of duration of NSAID use.

Helicobacter Pylori

H-pylori is a small, curved gram negative micro aerophilic rod bacteria with multiple polar flagellae. Main characteristic features of this organism is its ability to hydrolyze urea, which leads to production of ammonia. This causes release of gastrin from antral G

cells which is probably responsible for hypergastrinemia in peptic ulcer patients, which in turn may result in gastric acid hypersecretion. It also leads to the disruption of the gastric mucosal barrier by the enzymes produced by the organism⁶.

Cigarette Smoking

Smoking impairs ulcer healing and promotes recurrence of ulcers and also increases the surgical risks⁷.

Miscellaneous

- Alcohol damages the gastric mucosal barrier
- Certain personality traits and psychological stress, or poor tolerance to stress leads to ulcer formation.
- Patients with blood group O have an increased risk of duodenal ulcer⁸.

Pathophysiology of Typhoid Perforations

Typhoid fever is caused by a Gram-negative Bacillus Salmonella typhi. The organism passes through the Peyer's patches without causing any inflammation. It multiplies in the reticuloendothelial system for 10-14 days. After 1 week of infection, the bacteria are shed into the small bowel and therefore appear in the stool. The early change evident is the hyperplasia of the lymph follicles. The Peyer's patches become swollen and ulcerated, which can progress to capillary thrombosis and subsequent necrosis. In 2nd week, necrosis and sloughing occur and ulceration of the follicles leading on to perforation in the 3rd week of disease⁹.

Keenan observed in his study that 88% of patients perforated in the second week¹⁰. Santillana reported a patient who perforated within 24 hours of onset of clinical illness¹¹. The timing of perforation in a study of 59 children reported by Lizzaralde¹²

Pathology

Salmonella typhi causes enlargement of reticuloendothelial and lymphoid tissue throughout the body. Proliferations of the phagocytic cells swells the

lymphatic submucosal nodules of the entire gut mainly Peyer's patches of the terminal ileum¹³. Now this area will be sharply delineated plateau like elevations up to 8mm in diameter bulging into the intestinal lumen. During 2nd week of infection, the mucosa over the swollen ileal lymphoid tissue is shed, resulting in oval ulcers with their long axis in the direction of bowel flow. Perforation occurs because of rupture of necrotic Peyer's patches caused by distension of bowel or by excessive peristalsis. Hadley reported that most of the perforations are smaller than 5mm¹⁰. Tarpley noted that the size of the perforation varied between 1mm and 6cm in size with most being less than 8mm in size¹⁴ and his study showed multiple perforation in 20% of patients. Hadley reported multiple perforations in 17% of patients varying from two to six. Santillana reported two perforations in 16% of patients and more than two perforations in 6% of patients¹⁵. Mock et al reported the number of perforations in their series¹⁶.

Clinical Features

Eggleston reported that most of the typhoid patients had fever, malaise and sudden hyper resonance on percussion was noted over the liver in 70% of patients and paralytic ileus in 68% of patients. 19.2% of patients were in shock¹⁷.

Site of Perforation In Typhoid Fever

Since the Peyer's patches are more in the terminal ileum, the incidence of typhoid perforation is also more in the terminal ileum. Kim in 1975 obtained 86% cases of perforation occurred in the last 60cm of ileum of which 72% perforations were within the last 40cm¹⁸.

In Kuruvilla's study in 1978 perforations were confined to the 30cm proximal to terminal ileum¹⁹. Purohit et al noted that all the typhoid ileal perforations occurring within 40cms proximal to the ileo-cecal junction²⁰.

Typhoid ileal perforation (Figure 1) also showed seasonal variation with more commonly occurring in the midst of

the year. Eggleston's study showed that most of the case got presented between July and October¹⁷. Hadley reported that 58% of typhoid perforation cases occurred in the dry season¹⁰.

Pathophysiology of Intestinal Tuberculosis

Tuberculosis can affect any part of the Gastrointestinal tract. Wig et al reported that all their 10 patients perforated through the ulcer²¹. The incidence of perforation in tuberculous enteritis (Figure 2) has been reported to be between 1 and 10%. Multiple strictures can also be seen with perforations. Kakar's study found multiple perforations in 36.3% of cases and strictures in 72.6%²². Agarwal et al detected tuberculosis as the etiology in 9 out of 113 specimens of ileal perforations examined²³.

Pathophysiology of vascular disorders

Acute mesenteric ischaemia²⁴

Acute mesenteric ischemia (AMI) is defined as an interruption of the blood supply to varying portions of the small intestine, leading to ischemia and secondary inflammatory changes. If untreated, this process will eventuate in life threatening intestinal necrosis.

Pathology

Acute arterial ischemia may arise from an embolus or from a thrombus on an underlying stenosis. It may also occur because of low cardiac output state. Other rare causes include aortic dissection, intimal hyperplasia associated with oral contraceptive pills, systemic lupus erythematosus, arteritis associated with rheumatoid arthritis, fibromuscular dysplasia and polyarteritis nodosa.

Pathophysiology Of Strangulated Hernia²⁵

A hernia is said to be strangulated when the contents of the sac are so constricted as to interfere with their blood supply. Usually, the small intestine is involved in the strangulation than the large intestine. There will be no

cough impulse, extremely tense and tender. These are followed by acute intestinal obstruction. Gangrene may occur as early as 6 hours after the onset of first symptoms.

Pathology

Here intestine is obstructed & its blood supply hampered. Initially only venous return is impeded, because of that the wall of the intestine becomes congested and bright red with the transudation of serous fluid into the sac. As congestion increases, the wall of the intestine becomes purple in color. As venous stasis increases, arterial supply becomes more and more impaired. Blood is extravasated under serosa and is effused into the lumen. The fluid in the sac now becomes blood stained. At this stage, the walls of intestine have lost their tonicity and become friable. Bacterial translocation also occurs. Gangrene first appears at rings of constriction then at anti mesenteric border. If the strangulation is not relieved, perforation of the wall of the intestine occurs and peritonitis spreads from the sac to peritoneal cavity.

Pathophysiology Of Small Bowel Lymphomas²⁴

Most of small bowel lymphomas are non-Hodgkin's lymphoma. They can be B- cell or T- cell lymphoma. They are further subdivided into low grade and high grade.

The commonest types of Intestinal Lymphomas are

1. MALT(mucosa associated lymphoid tissue) lymphoma
2. Centrocytic lymphoma
3. Mediterranean lymphoma
4. Burkitt type lymphoma
5. Polymorphic T-cell lymphoma.

Pathophysiology of Diverticular Disease

Meckel's Diverticulitis

Meckel's diverticulitis is a congenital diverticulum occurs in 2% of patients, usually 2 inches in length and

are situated 2 feet from the ileocecal junction. It has all three layers of the bowel. It represents patent vitello-intestinal tract. Gastric mucosa is found in 38% of Meckel's diverticulum which may lead to may present with or without perforation (Figure 3) or may result from obstruction by food residue. There have been cases reported of Meckel diverticular perforation due to intact fish bone by Mouvaud ²⁷ and also case reported on Meckel diverticular perforation due to button battery by Karaman A²⁶.

Duodenal Diverticula

The common site for diverticulum formation is duodenum. Most of the duodenal diverticula perforations are often retroperitoneal, asymptomatic, and rarely include peritoneal irritation, making clinical diagnosis difficult. Nevertheless, complications are extremely rare and include hemorrhage, inflammation, compression of surrounding organs, neoplastic progression, cholestasis and perforation²⁸.

Jejunal Diverticula

Jejunal diverticula are pseudo diverticula which are usually of variable size & multiple. Perforation due to jejunal diverticuli are rare and peritonitis due to this is localized and self-limiting because usually perforation happens in the mesenteric border of jejunum and mesentery will seal the perforation²⁹.

Pathophysiology Of Miscellaneous Conditions

Radiation Enteritis²⁵

The immediate effect of radiation on the gastrointestinal tract is arrest of cell division in the intestinal crypts and the cell arrest takes place in G1 phase. Because of radiation, small intestinal mucosa becomes thinner with stunted villi. The incidence of intestinal radiation induced bowel disease vary from 3 to 25%.

Other risk factors include age, presence of comorbidities, prior operation, tobacco abuse, and concurrent

chemotherapy³⁰. Mucosal atrophy with atypical hyperplastic glands and intestinal wall fibrosis, and telangiectasia can be typical histologic changes³¹.

The interval between the tissue radiation and onset of symptoms varies considerably from 2 months to 2 years. Intestinal obstruction may be acute or subacute or recurrent. Occasionally acute presentation with infarction may occur and this carries a high risk of perforation and mortality.

Necrotising Enterocolitis²⁵

This is more common in premature neonates. The risk of necrotizing enterocolitis is inversely proportional to birth weight. It is associated with hypoxia, hypothermia, hypotension and umbilical artery cannulation. Ileum, caecum, distal colon, and total colon are affected with a complete spectrum from mucosal to transmural necrosis that leads to perforation.

Meconium Peritonitis²⁵

It is an aseptic peritonitis that develops late in intrauterine life, during, or just after delivery. Meconium is a sterile mixture of epithelial cells, mucin, salts, fats, and bile which enters the peritoneal cavity through an intestinal perforation and in over 50% of cases the perforation is the result of some form of neonatal intestinal obstruction. Meconium is sterile up to 3 hours after birth after wards it leads to acute bacterial peritonitis.

Traumatic Perforation

Blunt abdominal injuries make up 80% of the abdominal injuries in emergency departments, and most of these are related to motor vehicle accidents. Approximately 13% of the patients with blunt abdominal injuries suffer from intra-abdominal injuries³². After injuries to the spleen and liver, traumatic injury to the small bowel is the most common.³³

Excessive elapsed time to surgery can lead to significant morbidity and/or mortality³⁴. After confirming a diagnosis of traumatic small bowel perforation, definitive repair or resection must be performed as soon as possible within 24 hours³⁵.

The Organ Injury scales proposed by the American Association for the Surgery of Trauma are the most widely used injury classifications for traumatic injury to the small intestine.³⁶

From the present study, it has been proven that most common cause for small bowel perforation is typhoid ileal perforation accounting for 43.3% cases. Kishore Kumar et al studied typhoid ileal perforation for a period of 2 years in a tertiary care hospital in south India and concluded that the rate of ileal perforation due to typhoid fever was around 8.4 %.³⁷ Second most common cause is tubercular perforation of small bowel affecting 23.3% of patient in this study. These two etiologies have constituted more than 65% of cases in the present study. Thus, proving that most common causes of small bowel perforation in Indian subcontinent are typhoid perforation and tubercular perforation.

The increasing number of tubercular perforations may be due to increase in population density. In northern part of India where there is high population density, has a greater number of TB (tuberculosis) cases getting reported. Most of the cases presenting with tubercular ileal perforation were on anti-tubercular therapy. Ming J Lee et al concluded that gastrointestinal TB may result in intestinal obstruction and perforation even after antitubercular therapy has initiated. Despite surgical intervention, tubercular perforation has high complication & mortality rate, and it is difficult to predict the subgroup of patient with abdominal TB who progress to perforation.³⁸

The third most common cause for small bowel perforation is nonspecific ulceration means there is no identifiable cause for the perforation. In present study it has accounted for 13.3% of cases. Most common site of nonspecific ulcer is ileum. According to Boydston.J. Setal, most common site of nonspecific ulcers was ileum³⁹, which has been proved in this study. But most common site of perforation in nonspecific ulcer is jejunum which is seldom proven because there were no cases of nonspecific ulceration in jejunum reported in our study.

Spontaneous perforation due to nonspecific ulceration requires immediate diagnosis and surgical intervention. Matsumoto et al⁴⁰ and maiden et al⁴¹ has studied the nonspecific ulcers of small intestine due to NSAID use and, their study has supported that intestinal mucosal damage has been seen in healthy volunteers by using NSAID via capsule endoscopy.

Next common cause for perforation in this study was peptic ulcer perforation. 10% of patient had peptic ulcer perforation in duodenum. The most common site of peptic ulcer perforation is first part of duodenum. Most common factor responsible for peptic ulcer perforation are Helicobacter Pylori infection and chronic NSAID use.

Small bowel perforations are rarely caused by malignancy. In this study, there was 1 patient with perforation who had ovarian malignancy ileostomy. Tzu Chech Chao et al studied small intestinal perforation due to malignant tumors. In his study it was observed that malignant tumors caused small intestinal perforation. In his study most of them underwent resection and anastomosis with primary repair and loop ileostomy⁴².

Traumatic perforation of small intestine is a rare etiology. In present study 1 patient had jejunal perforation due to road traffic accident who sustained blunt abdominal

trauma with multiple bone fracture. Ping-tze Chen, Hong Ming chao et al studied small bowel perforation due to blunt abdominal trauma. There inference was, after injuries to spleen & liver, traumatic injury to small bowel is most common. They studied traumatic perforation on 5 patients. Of which 3 had ileal perforation and 2 had jejunal perforation. Delayed diagnosis of traumatic small bowel perforation leads to significant morbidity and mortality⁴³.

Present study showed male predominance with 73.3% patients were male and 26.7% were female. Usually, small intestinal perforation has a male predominance which may be due to the risk factors that favoring to male sex such as smoking, tobacco chewing, alcohol intake, long term NSAID use, hypertension and blood group A.

When studied the age distribution, there were only 3 patients (10%) under the age of 20 years. Maximum number of cases were found in 41-50 age group, which constitutes 23.3% patient. 2nd highest number of cases were found in 61 to 70 age group which constitute 20% patient. This study findings were concurrent with previous studies that showed higher incidence of male compared to female, but the age distribution was found to be different in preceding studies. Talwar et al observed that most of the patient in his study fell into 21-30 years age group.⁵ In study conducted by Chatterjee et al, maximum number of patients came into 2nd and 3rd decade and male to female ratio was 2.2:1.⁴⁴

Rajesh Singh Jobta et al studied perforation peritonitis and he found that in his study, male to female ratio was 5:1 and maximum patients were in 31-40 years age group¹. In more recent study conducted on non-traumatic small bowel perforation by Ahmet Turkoglu et al, male to female ratio is 1.3:1 and mean age was 51 yrs⁴⁵.

In the present study more than 65% of patient presented with peritonitis features. Patient with enteric fever,

tuberculosis, and nonspecific ulceration presented with fever, abdominal pain, vomiting and obstipation. Chatterjee et al in their study of ileal perforation observed that pain abdomen was the principal presenting features (92.3%), next in order were constipation (63.6%) and fever (44.3%)⁴⁶.

Most common site of small intestine perforation in the present study is ileum. Out of 30 patients 20 had ileal perforation which constitute 66% of total cases. Most common cause for ileal perforation in this study is enteric fever. Second most common site is duodenum comprising 20% of total cases. Most common cause for duodenal perforation is peptic ulcer disease. The study conducted by Singh S et al has also showed that most common site of perforation is ileum (62.22%)⁴⁶. Ahmet Turkoglu et al observed that 80% of small bowel perforation is seen in ileum⁴⁵. But in study conducted by Shahidi Parveen Afridi et al, the most common site of perforation was seen in duodenum (43.9%)⁴⁸.

In this study 76.7% had single perforation. 20% patients had double perforation and 3.3% patients had multiple perforation. In a study conducted by Ahmet Turkoglu et al, he observed that 70% patient had single perforation and rest had multiple perforation⁴⁵.

When we studied the time interval between admission and surgical intervention, it has been found that 80 % got operated within 10 hours. In that 66.6 % patient got operated within 6 hours.

When we observe the mortality of the present study, there are many factors, which influence the mortality of small bowel perforation. General condition of the patient when presenting to the hospital, presence of shock, signs of fecal peritonitis, presence of leukocytosis, elevated creatine level, leucopenia, presence of co- morbid condition like smoking, hypertension, and delayed presentation more than 24 hours.

In present study 5 out of 30 patients died of small bowel perforation despite of surgical intervention. In that 80% had feculent and purulent peritoneal fluid drained which was suggestive of fecal peritonitis which had impact in the mortality of small bowel perforation. 60% got positive for Klebsiella in their peritoneal fluid culture study. 80% of mortality was seen in ileal perforation. Out of 5 patients, 2 patients had typhoid ileal perforation, 2 patients had tubercular perforation, 1 patient had traumatic jejunal perforation.

In the present study, when we studied the perforation edge biopsy it has been observed that relying only on histopathological findings to attain a diagnosis is not enough. It should be correlated with clinical and biochemical findings. Here in the present study, histopathological findings of 17(60%) cases did not correlate with any etiological diagnosis. In present study 43.3% cases were diagnosed as typhoid perforation in which 23.3% cases were diagnosed directly using histopathological findings. Remaining were proved using clinical and biochemical reports. If we investigate tubercular perforations only 4 out of 7 cases were proved using histopathological findings. Sharma et al studied perforation edge biopsy of 165 patients. In his study only 53 patients got diagnosed using perforation edge biopsy with most common etiology as typhoid⁴⁹. These studies concluded that perforation edge biopsy was diagnostic only in 1/3rd of cases of small bowel perforations.

Summary And Conclusion

This is a prospective study done at teaching hospital affiliated to author's medical college over a period of 18 months from March 2021 to August 2022. In the set of proforma, relevant signs and symptoms along with the clinical examination were recorded. On the day of admission patients were provisionally diagnosed as small bowel perforation case and in the Emergency room based

on the clinical presentation and supporting radiological evidence. Definitive diagnosis established later at the time of surgery after evaluating the intraoperative findings.

As we conclude:

- The most common cause of small intestinal perforation is typhoid ileal perforation accounting for 43.3% cases. It is followed by tubercular perforation, nonspecific ulceration, and peptic ulcer perforation.
- Most of the patients presented in the 4th and 6th decade of life comprising of 43.3% of total cases.
- The study showed male predominance with sex ratio of 2.75:1.
- In this study 80% cases were managed within 10 hours of admission with a mortality of 4 cases that is 8%.
- Most of the ileal perforation patient presented with feculent and purulent peritoneal fluid.
- Factors like ileal site perforation, fecal peritonitis, Klebsiella in peritoneal fluid had strong impact on mortality rate of the present study.
- All the cases were reported between March to September which shows that small bowel perforation cases are more common in the midst of the year. No cases were reported in between October and March.

References

1. Jhobta RS, Attri AK., Kaushik R. Spectrum of perforation peritonitis in India-review of 504 consecutive cases. *World J Emerg Surg* 1, 26; 2006
2. BhanuPrakash KR, Aruna MS, Shetty KK. Clinical study and management of small bowel perforation in a tertiary care-teaching institute. *Int Surg J.* 2018; 5:855-9.
3. Singla, Sahil & Verma, Surender & Garg, Pradeep & Verma, Anjali & Noori, Md & Yadav, et al. Pattern and Etiology of Patients with Gastrointestinal Perforations: An Observational Prospective Study. *International Journal of Contemporary Medical Research [IJCMR].* 6. 10.21276/ijcmr.2019.6.4.44
4. Singh S, Singh K, Grover AS, Kumar P, Singh G, Gupta DK. Two-layer closure of typhoid ileal perforations: a prospective study of 46 cases. *Br J Surg.* 1995 Sep;82(9):1253.
5. Malhotra M., Singal R., Chowdhary K., Sharma R, Sharma S, Dhankhar A. Spectrum of Perforation Peritonitis in a Rural Medical College. *Bangladesh Journal of Medical Science*;2016 .15(1), 70-73
6. Chey WD, Wong BC. American College of Gastroenterology guideline on the management of Helicobacter pylori infection. *Am J Gastroenterol.* 2007 Aug;102(8):1808-25.
7. Maity P, Biswas K, Roy S, Banerjee RK, Bandyopadhyay U. Smoking and the pathogenesis of gastroduodenal ulcer--recent mechanistic update. *Mol Cell Biochem.* 2003 Nov 253(1-2):329-38.
8. Buckwalter JA, Wohlwend EB, Colter DC, Tidrick RT, Knowler LA. peptic ulceration and abo blood groups. *jama*:1956;162(13):1215–1220.
9. Christie AB. *Infectious Diseases: Epidemiology and Clinical Practice.* 4th ed. Edinburgh, Scotland: Churchill Livingstone; 1987
10. Keenan JP, Hadley GP. The surgical management of typhoid perforation in children. *Br J Surg.* 1984 Dec;71(12):928-9.
11. Santillana M. Surgical complications of typhoid fever: enteric perforation. *World J Surg.* 1991 Mar-Apr; 15(2): 170-5
12. Lizarralde E. Typhoid perforation of the ileum in children. *J Pediatr Surg.* 1981; 16:1012–1016.
13. Shu-Kee Eng, Priyia Pusparajah, Nurul-Syakima Ab Mutalib, Hooi-Leng Ser, Kok-Gan Chan & Learn-

- Han Lee. Salmonella: A review on pathogenesis, epidemiology and antibiotic resistance, *Frontiers in Life Science*.2015; 8:3;284-293
14. Donald E Meier, Obioha O, Imediegwu, John L Taripley. Perforated typhoid enteritis:Operative Experience with 108 cases. *Am J Surg*, 1989; 157: 423-427.
15. Santillana M. Surgical complications of typhoid fever: Enteric perforation. *World J Surg*. 1991; 15:170-5.
16. Mock CN, Amaral J, Visser LE. Improvement in survival from typhoid ileal perforation. Results of 221 operative cases. *Aim Surg*. 1992; Mar;215(3):244-9.
17. Eggleston FC, Santoshi B, Singh CM Typhoid Perforation of Bowel. *Ann Surg* 1979;190(1): 31-35
18. Kim JP, Oh SK, Jarrett F. Management of ileal perforation due to typhoid fever. *Ann Surg*. 1975; Jan;181(1):88-91
19. Kuruvilla MJ. Role of resection in typhoid perforation. *Ann R Coll Surg Engl*. 1978; Sep;60(5):408-11
20. Purohit. Surgical treatment of Typhoid perforation. *Indian Journal of Surgery*. 1978; 40: 227.
21. Wig JD, Chaudhary A, Gupta NM. Free perforation of tuberculous ulcers of small bowel. *md j Gastroenterol*, 1985; 4(4): 241-254.
22. Arun Kakar, Aranya RC, Nair SK. Acute perforation of small intestine due to tuberculosis. *Aust N Z J Surg*. 1983;53: 381-383
23. Agarwal S, Gera N. Tuberculosis-an underestimated cause of ileal perforation. *J Indian Med Assoc*. 1996; Sep;94(9):341, 352
24. Essential surgical practice - 4th Edition. A Cuscieri / J.C. Steele / A.R.Moosa
25. Bailey and love's short practice of surgery – 24th Edition. R.C.G. Russel ,N.S. Williams , C.J.K. Bolstrode.
26. Karaman A, Karaman I, Erdoğan D, Cavuşoğlu YH, Aslan MK, Varlikli O, et al. Perforation of Meckel's diverticulum by a button battery: report of a case. *Surg Today*. 2007;37(12):1115-6.
27. Mouawad NJ, Hammond S, Kaoutzanis C. Perforation of Meckel's diverticulum by an intact fish bone. *BMJ Case Rep*. 2013; Feb 20;2013
28. Costa Simões V, Santos B, Magalhães S, Faria G, Sousa Silva D, Davide J. Perforated duodenal diverticulum: Surgical treatment and literature review. *Int J Surg Case Rep*. 2014;5(8):547-50.
29. Singh S, Sandhu HP, Aggarwal V. Perforated jejunal diverticulum: A rare complication. *Saudi J Gastroenterol*. 2011; Sep-Oct;17(5):367.
30. Turina M, Mulhall AM, Mahid SS, Yashar C, Galandiuk S. Frequency and surgical management of chronic complications related to pelvic radiation. *Arch Surg*. 2008; 143:46-52.
31. Kim JB, Lee JL, Park SH, Kim J, Kim JC. Acute Ileal Perforation Caused by Radiation Enteritis After Restoration. *Ann Coloproctol*. 2021; Jul;37(Suppl 1): S51-S54.
32. Nishijima DK, Simel DL, Wisner DH, Holmes JF. Does this adult patient have a blunt intra-abdominal injury? *JAMA*. 2012; 307:1517-27
33. Isenhour JL, Marx J. Advances in abdominal trauma. *Emerg Med Clin North Am* 2007; 25:713-33
34. Almeida AB, Moreira H, Barbosa E, Correia-da-Silva P, Costa-Maia J. Prognostic factors for traumatic bowel injuries: Killing time. *World J Surg*. 2012; 36:807-12
35. Schreiber MA. Damage control surgery. *Crit Care Clin*. 2004; 20:101-18 Faria GR

36. Moore EE, Cogbill TH, Malangoni MA, Jurkovich GJ, Champion HR, Gennarelli TA, et al. Organ injury scaling, II: Pancreas, duodenum, small bowel, colon, and rectum. *J Trauma*. 1990 Nov;30(11):1427-9
37. Markapuram, Kishore Kumar et al. Typhoid ileal perforation: a two-year study at a tertiary care hospital of South India. *International Surgery Journal*, [S.l.].2018; May: 2159-2164,
38. Lee MJ, Cresswell FV, John L, Davidson RN. Diagnosis and treatment strategies of tuberculous intestinal perforations: a case series. *Eur J Gastroenterol Hepatol*. 2012; May;24(5):594-9.
39. Boydston JS, Gaffey TA, Bartholomew LG. Clinicopathologic study of nonspecific ulcers of the small intestine. *Digest Dis Sci* **26**,1981; 911–916.
40. Matsumoto T, Iida M, Matsui T, Yao T, Watanabe H, Yao T, et al. Non-specific multiple ulcers of the small intestine unrelated to non-steroidal anti-inflammatory drugs. *J Clin Pathol*. 2004;57(11):1145-50
41. Maiden L. Capsule endoscopic diagnosis of nonsteroidal antiinflammatory drug-induced enteropathy. *J Gastroenterol*. 2009;44(Suppl 19):64-71
42. Tzu-Chieh Chao, Hsiao-Hsiang Chao, Yi-Yin Jan, Miin-Fu Chen, Perforation Through Small Bowel Malignant Tumors, *Journal of Gastrointestinal Surgery*, Volume 9, Issue 3, 2005; Pages 430-435.
43. Chen PT, Chao HM. Experience in traumatic small bowel perforation management. *Formos J Surg* 2018; 51:32-7
44. Chatterjee H, Pai D, Jagdish S, Satish N, Jayadev D, Srikanthreddy P. Pattern of nontyphoid ileal perforation over three decades in Pondicherry. *Trop Gastroenterol*. 2003;24(3):144-7
45. Türkoğlu A , Ülger B , Uslukaya Ö, Oğuz A , Zengin Y , Taş İ , et al. Patient management and clinical outcomes in non-traumatic small bowel perforations. *Journal of Clinical and Experimental Investigations*. 2015; 6(2): 130-134.
46. Singh S, Satsangi A, Yadavalli SD, Singh B, Patil G. Nontraumatic Small Bowel Perforation-A Review of Demographics, Aetiological Factors, Clinical Presentation, Radiological Findings Along with Hematological and Histopathological Evaluation. *World J Surg Surgical Res*. 2020; 3: 1244.
47. Nadkarni KM, Shetty SD, Kagzi RS, Pinto AC, Bhalerao RA. Small-bowel perforations. A study of 32 cases. *Arch Surg*. 1981;116(1):53-7.
48. Afridi SP, Malik F, Ur-Rahman S, Shamim S, Samo KA. Spectrum of perforation peritonitis in Pakistan: 300 cases Eastern experience. *World J Emerg Surg*. 2008; Nov 8; 3:31.
49. Mahajan G, Kotru M, Sharma R, Sharma S. Usefulness of histopathological examination in nontraumatic perforation of small intestine. *J Gastrointest Surg*. 2011 Oct;15(10):1837-41.

Legends Figures



Figure 1: Typhoid Ileal Perforation

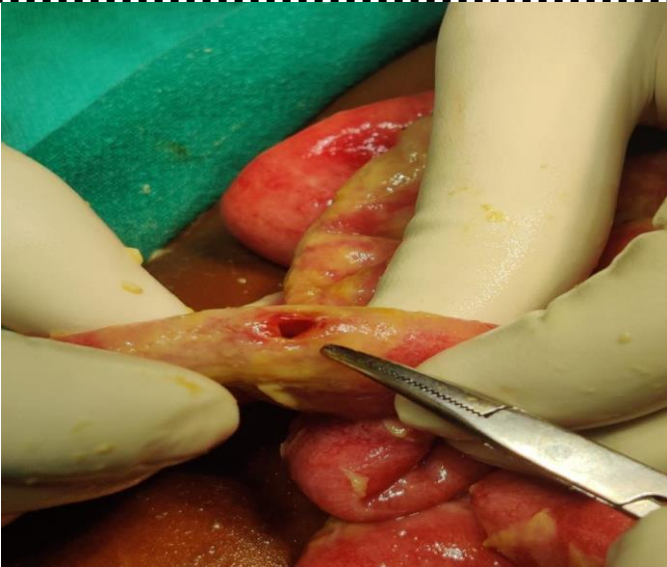


Figure 2: Tubercular Ileal Perforation



Figure 3: Perforation of Meckel's Diverticulum