Chapter

Early Recognition and Management of Small Bowel Perforation

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Abstract

Enteroscopy has a procedure-related perforation rate from less than 1% to 6.5%. It seems to be higher in therapeutic enteroscopy, especially polypectomy of large polyps, and in patients who have altered surgical anatomy. Early recognition is life-saving and studies have shown that if surgery is done within 12 hours of perforation the prognosis is better. In a patient who has undergone small bowel endoscopy the diagnosis of small bowel perforation should be suspected if the patient has acute pain in the abdomen. Early diagnosis should be the goal with prompt surgical correction.

Keywords: small bowel perforation, peritonitis, laparoscopy, enteroscopy, small bowel endoscopy

1. Introduction

Enteroscopy has a procedure-related perforation rate from less than 1% to 6.5% [1–3]. It seems to be higher in therapeutic enteroscopy, especially polypectomy of large polyps, and in patients with altered surgical anatomy. Early recognition is life-saving and surgery performed within 12 hours carries a better prognosis. It was seen in peptic perforations that a delay of more than 24 hours increased mortality seven to eight times, complication rate to three times, and length of hospital stay to two times, compared with a delay of 6 hours or less [4]. Early diagnosis should be the goal followed by prompt surgical correction.

2. Bowel pathologies that increase the risk of perforation during small bowel endoscopy/enteroscopy

Bowel pathologies with increased susceptibility for perforation during small bowel endoscopy include – Crohn's disease, anastomotic stricture, radiation stricture, altered surgical anatomy (ileoanal, ileocolic anastomosis), and intestinal lymphoma. The perforation rate during double balloon enteroscopy is seen more with the retrograde technique compared to anterograde [5]. Also, more perforations are seen with therapeutic procedures like polypectomy of large polyp (> 3 cm), argon plasma coagulation for AV malformations, and dilations of small bowel strictures [3, 5, 6]. Furthermore, endoscopy associated perforations are more in patients

with inflammatory bowel disease (IBD) as compared to non-IBD patients, with disease severity and steroid use being the two of the strong predictors for perforation [7–10]. In a systematic review, the total rate of perforation with enteroscopy in Crohn's disease was 4.27 per 1000 procedures (diagnostic and therapeutic procedures) and it was nearly 4 times that of diagnostic balloon assisted enteroscopy for all indications (1.1 per 1000 procedures) [11].

3. Early recognition of perforation by simple bedside examination

In a patient who has undergone small bowel endoscopy the diagnosis of small bowel perforation should be suspected if the patient has acute pain in the abdomen. The severity of pain will progressively increase. The patient will lie still as any movement will exacerbate the pain. Even the respiration will be shallow for this reason. This differentiates it from other acute pathologies like acute pancreatitis in which the patient is restless and changes posture to find relief. The physical examination will reveal a sick look, tachycardia, and features of dehydration along with the signs of peritonitis. Perforation causes third space loss of body fluid. This along with bacteremia and systemic inflammatory response leads to hypotension and decreased urine output. The abdomen will be very tender and guarding will be present. A board-like rigidity may be felt. Loss of liver dullness on percussion will further confirm the presence of free air in the peritoneal cavity. Bowel sounds will be absent due to paralytic ileus caused by peritonitis. After 4–6 hours of perforation (gastro-duodenal perforation), the peritoneal cavity acid becomes diluted and there is a decrease in pain and guarding. It may seem that the patient is improving but, in reality, is deteriorating [12].

Making the diagnosis of perforation may be difficult in the early period because of subtle signs and symptoms. The classical peritoneal signs may fail to elicit in a morbidly obese patient. Thus a high index of suspicion should be kept in mind for patients complaining of undue pain following endoscopy. Any patient with difficult endoscopy should have close post procedure monitoring for early detection of complications. Tachycardia, dehydration, or decreased urine output should alarm the clinician. Repeated abdominal examination can detect any new abdominal signs. Lessons can be learnt from trauma surgery. In a hemodynamically stable patient with an anterior abdominal stab wound with the peritoneal breach, serial abdominal examination is a standard technique for picking the peritonitis early.

4. Role of basic laboratory investigation like TLC and serum lactate in early diagnosis

Laboratory workup will confirm the diagnosis of small bowel perforation apart from a careful history and physical examination. It is particularly helpful in elderly or seriously ill patients in whom signs and symptoms are less reliable. An elevated (>12,000/ cumm) or decreased white blood cells (< 4000/cumm) confirms inflammation or infection [13]. If TLC is normal, an increase in the number of neutrophils in differential counts or bandemia (> 10% band forms) is indicative of infection. The hemoglobin level will help in deciding the blood transfusion requirement. Serum electrolytes, blood urea nitrogen and, serum creatinine measurements will provide information about the fluid losses associated with third space loss, vomiting, delayed presentation, etc. Lactate level serves as a surrogate marker for tissue perfusion and correlates with anaerobic metabolism. A raised lactate level indicates bowel ischemia, shock, and sepsis. Lactate levels have been more specific than leukocyte count in diagnosing abdominal sepsis [14]. However, lactate levels can also be elevated in hepatic

failure, dehydration, and drug abuse. Metabolic acidosis will be present in sepsis. Coagulation profiles such as platelet count, prothrombin time, international normalized ratio, etc. are important in the preoperative assessment of patients with liver disease or those on anticoagulants. These may also be deranged due to sepsis. Other biochemical markers of inflammation include C-reactive protein and pro-calcitonin which when used in adjunct with complete blood count and other clinical signs help in making the diagnosis, assessing severity and prognosis, and guiding treatment.

5. Role of X-ray abdomen and CT scan in confirming the diagnosis

Plain radiography remains the most frequently ordered examination in patients with suspected perforation. Pneumoperitoneum is present in the rupture of any hollow viscous. It may also be observed following recent abdominal surgery, paracentesis, and pneumatosis intestinalis. Benign pneumoperitoneum may rarely develop following endoscopy due to transmural passage of insufflated air without bowel perforation [15]. Plain radiography can detect about 55–85% of patients with pneumoperitoneum [16]. It can detect as little as 1–2 ml of free air [17]. Upright lateral chest radiograph has better sensitivity than upright postero-anterior chest radiograph [18]. Upright positions including left lateral decubitus are uncomfortable in critically ill patients in the emergency setting. In such patients supine decubitus anteroposterior view of the thorax and anteroposterior or lateral view of the abdomen are generally requested [19].

Free air can be visualized in different shapes, sizes, and locations in the abdominal cavity. On upright postero-anterior chest or abdominal radiography, free air is visualized as a translucent crescent below the diaphragm (**Figure 1**). These free-air signs can be categorized as bowel-related, right-upper-quadrant, peritoneal ligament- related, or other signs [20]. Rigler sign is the visualization of both sides of the bowel wall in a supine abdominal radiograph (**Figure 2**). The presence of normal gas

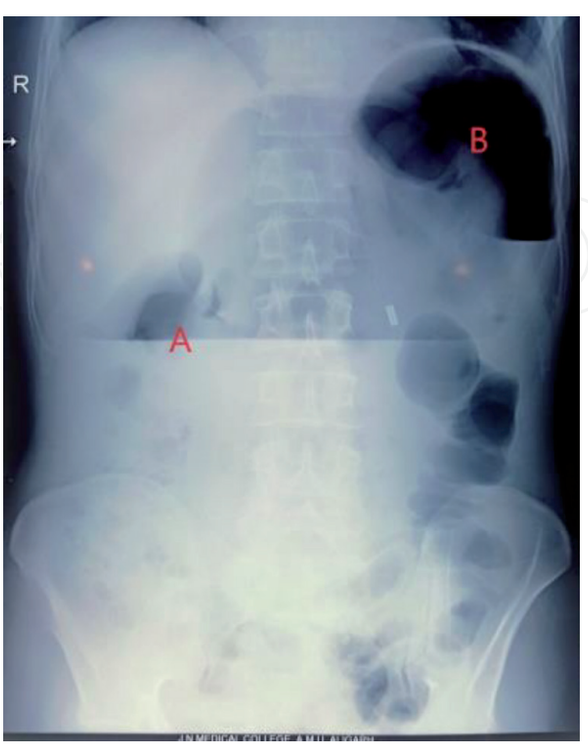

Figure 1.
X-ray abdomen showing A-Giant pneumoperitoneum appearing as an air-fluid level in the peritoneal cavity. B-pneumoperitoneum on the left side may be confused with fundal gas.

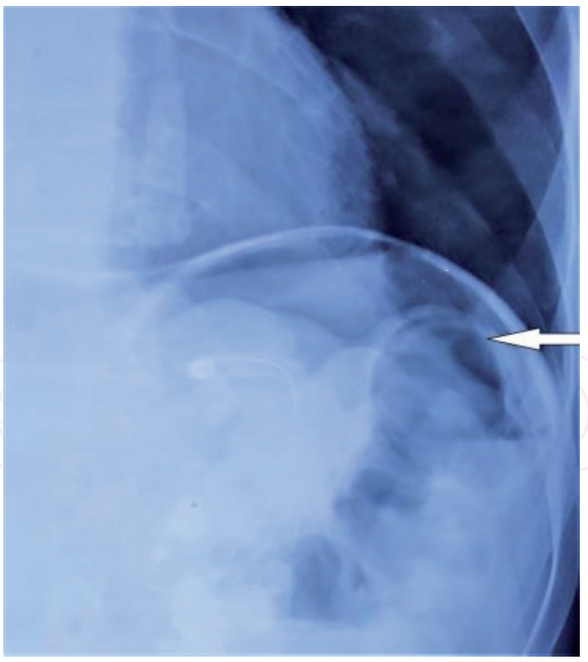

Figure 2.
Rigler sign.

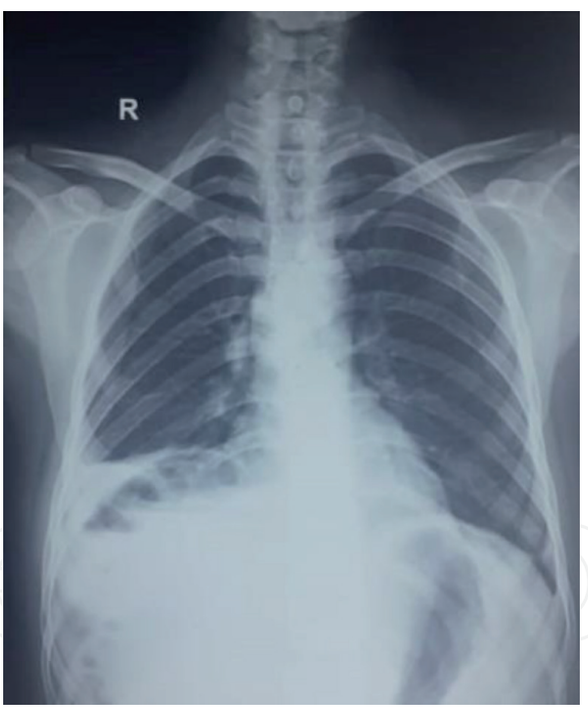

Figure 3.
X-ray chest showing Chilaiditi sign.

in the bowel lumen, as well as free extraluminal gas, makes the bowel wall outline nicely visible. It is seen when a large quantity of free gas is present in the abdomen. Hyperlucent liver sign is also seen in a supine radiograph. Intraperitoneal free air may outline the various peritoneal ligaments making them visible along their course giving rise to various signs: falciform ligament sign, ligamentum teres sign, "inverted V" sign, urachus sign, etc. [20]. Along with it air in the subcutaneous tissue can also be visualized. Pneumoperitoneum is often absent in the perforation of the retroperitoneal duodenum. A confusing picture related to pneumoperitoneum is the Chilaiditi sign. It is the interposition of the bowel, commonly colon, between the right

hemidiaphragm and the liver. It can be falsely diagnosed as pneumoperitoneum. Features that are suggestive of Chilaiditi sign are gas between liver and diaphragm and haustra in the gas suggesting that it is bowel and not free air (**Figure 3**) [21].

Although plain radiography is good modality in suspected cases of hollow viscus perforation, ultrasonography can be helpful in certain scenarios because of the absence of radiation exposure, bedside availability, no pre-procedural preparation, and speed. It can be used in pregnant females and sick patients. It can detect free fluid in the abdomen and rule out other causes of acute abdominal pain. It may not help in the early period of perforation when the amount of free fluid is scant for detection.

Computed tomography (CT) scan is very sensitive and specific for perforation of the gastrointestinal tract (80–100%) [22]. It is more sensitive than plain radiography for small or retroperitoneal perforations. In addition to free air, it can also detect the location and size of perforation and any fluid collection. Direct CT signs of intestinal perforation are free gas and extra-luminal leak of oral contrast (**Figure 4**) [23]. Indirect signs include misty mesentery, fluid collection, bowel wall thickening, and extra-luminal fecal matter [24]. In a prospective study of 85 patients, the MDCT images confirmed the site of gastrointestinal tract perforation in 73 (86%) patients.

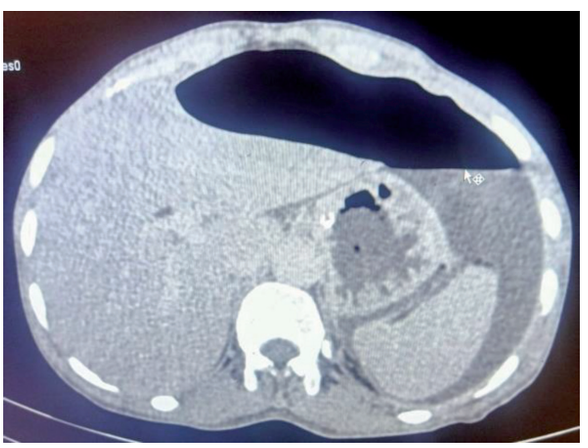

Figure 4.
CECT abdomen showing big pneumoperitoneum anteriorly and left side intra-abdominal collection. Same patient as shown in **Figure 1.**

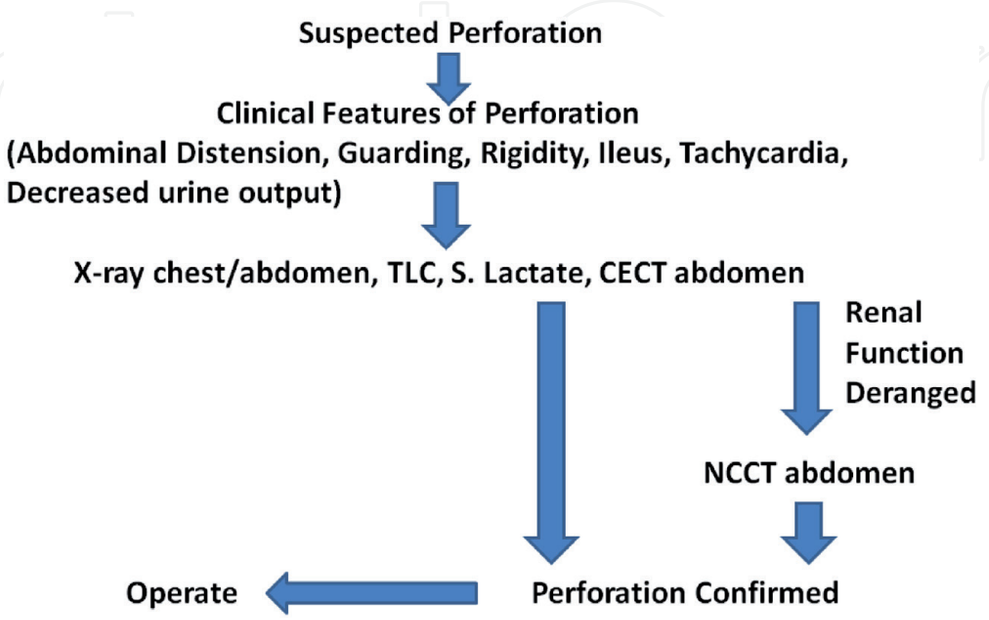

Figure 5.
Flowchart for the diagnosis of small bowel perforation.

Furthermore, the logistic regression showed that extra-luminal air, segmental bowel wall thickening, and focal defect of the intestinal wall were strong predictors of the site of perforation [25].

Signs present in plain radiography are also seen in scout view in CT. When contrast is contraindicated, then even plain CT is of help, in diagnosing perforation. The European Society of Gastrointestinal Endoscopy (ESGE) recommends that clinical features suggestive of perforation after an endoscopy should be rapidly and carefully evaluated and documented with a CT scan [26]. See flowchart for the diagnosis of intestinal perforation (**Figure 5**).

6. Resuscitation, supportive measures, and preparation for surgery

Evaluation and resuscitation should go hand in hand. The intravascular fluid deficit should be corrected considering systemic diseases in acutely ill patients. Warmed crystalloids (normal saline or lactated Ringer solution) should be started using wide-bore IV cannula. Fluid therapy should be guided according to physical signs (pulse rate, blood pressure), urine output, lactate levels, CVP, etc. Patients who are not responsive to adequate fluid therapy should be started on vasopressors. Nasogastric tube insertion prevents aspiration in patients with altered mental status and the elderly. Foley's catheterization is needed to measure urine output.

Parenteral analgesics (tramadol, paracetamol, NSAID, etc) should be started in an adequate dose in combination, keeping in mind the renal function of the patient. We generally avoid diclofenac in bowel repair as animal studies have shown an increased risk of post-surgery leak [27]. Broad-spectrum antibiotic therapy (piperacillin + tazobactum or meropenem, etc. along with metronidazole) should be started to control on-going sepsis. The antibiotics can later be continued as indicated or changed according to culture and sensitivity.

The anesthetic evaluation would include the American Society of Anesthesiologists (ASA) classification system to stratify patients according to the degree of perioperative risks [28]. Thromboprophylaxis should be started in high-risk patients that include mechanical devices (thromboembolic deterrent stocking and pneumatic compression boots) and drugs (heparin and LMWH) [29]. Risk factors for deep vein thrombosis include increased age, obesity, chronic diseases (diabetes, COPD, malignancy), corticosteroid therapy, and past or family history of thromboembolic disease. Written consent for surgery is taken and the patient and the family should be explained about the possibility of multiple staged surgeries, temporary stomas, postoperative ICU care, and expected complications of surgery.

7. The indication of laparoscopy in the diagnosis and management of intestinal perforation

Laparoscopy has a role in the diagnosis of perforations that are sometimes not detected by imaging tools. It allows complete visualization and exploration of the abdominal cavity. Laparoscopy is considered safe and a valid diagnostic tool and has a diagnostic benefit of 89–100% in the acute abdomen [30]. However, in cases of small bowel perforation, it is more of a therapeutic modality. Patients treated with laparoscopy have smaller incisions (**Figure 6**), reduced post-operative pain, early return of bowel movements, shorter hospital stay, and faster return to normal activity. Various factors limit the role of laparoscopy in patients with perforation peritonitis. Respiratory and hemodynamic stability is necessary before performing laparoscopy. Pneumoperitoneum affects the respiratory and cardiovascular parameters, thus patients with comorbidities

Figure 6.
Small incisions of laparoscopic surgery.

should be properly evaluated before the procedure. The presence of dense intra-abdominal adhesions and the expertise of the surgeon are other parameters that affect the feasibility of laparoscopic procedure [30, 31].

The choice of bowel repair technique depends upon the condition of the patient as well as the bowel. Primary suture repair can be done for small perforation. Resection of the involved bowel with anastomosis is required if the surrounding bowel is unhealthy or the perforation is large (more than 50% of the bowel circumference). The primary repair/anastomosis is at risk in conditions that impair healing. An obstructed, irradiated, inflamed, or ischemic intestine is traditionally considered high risk. Other than this, systemic factors like malnutrition, hypotension, diabetes, renal failure, chronic liver disease, anemia, steroid use, and other conditions causing immunocompromise lead to an increased risk of anastomotic failure [32]. If there are multiple risk factors for anastomotic leak then exteriorization of the perforated bowel as a stoma may be a safer option. It is followed by stoma closure after two to three months. However, in proximal jejunum, a stoma will lead to serious nutritional loss and if possible should be avoided. Complete lavage of all the abdominal recesses must always be done to prevent post-operative intra-abdominal collection (tertiary peritonitis). The patients have a good recovery after a timely repair.

8. Conclusion

In a patient who has undergone small bowel endoscopy the diagnosis of small bowel perforation should be suspected if the patient is presenting with an acute pain abdomen, especially after a therapeutic procedure.

The physical examination will reveal a sick look, tachycardia, and features of dehydration along with the abdominal signs of peritonitis.

Perforation is confirmed by x-ray abdomen, leucocytosis, and an increase in serum lactate. Computed tomography scan is very sensitive and specific for perforation of the gastrointestinal tract.

Early diagnosis should be the goal with prompt surgical correction, and the patients have a good recovery after timely repair.

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