

# Role of Multidetector Computed Tomography in the Diagnosis of Colorectal Perforations



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Colonic perforations can be classified into perforations that occur at the site of a localized pathologic process and cecal perforations that occur secondary to distal colonic obstructions. Rectal perforations may result from foreign bodies inserted into the rectum; moreover, deep rectal biopsies, polypectomy, improper cleansing enema, or thermometer placement may also lead to rectal perforation. Correct identification of the cause and site of the perforation is crucial for appropriate management and surgical planning. Multidetector row computed tomography has a pivot role in planning the type of operative treatment, the prognosis, and in assessing those patients who have clinical symptoms of peritonitis but no radiographic signs of perforation.

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## Introduction

All causes of gastrointestinal tract perforation involve loss of gastrointestinal tract wall integrity and the release of intraluminal contents into the normally sterile peritoneal cavity. Although all intraperitoneal gastrointestinal tract perforations are grave abdominal emergencies, colonic perforations that often result in peritonitis caused by fecal contamination are particularly dreadful.

Colon perforation is a rather uncommon event usually caused by malignancy, amebic colitis, diverticular disease, spontaneous perforation, stercoral ulceration, steroid therapy, trauma, and ulcerative colitis. Iatrogenic trauma is more likely to cause perforations in patients who have abnormal bowel than in those who have a healthy colon. Older patients, those who had prolonged treatment with steroids or radiation, and those with specific diseases, such as neoplasms, diverticulitis, and inflammatory bowel disease, are predisposed to perforation.<sup>1-3</sup>

Colon injury from blunt abdominal trauma is uncommon, being diagnosed in approximately 0.5% of all major blunt traumas and in 10.6% of patients undergoing laparotomy. Pathogenic mechanisms related to injuries of the small bowel and of the colon are: (1) a direct force crushing the gastrointestinal tract between the vertebrae and the anterior

abdominal wall; (2) a rapid deceleration producing a shearing force between fixed and mobile portions of the involved tract; and (3) a sudden increase in intraluminal pressure resulting in bursting injuries.<sup>4-6</sup> Most of these lesions are of partial thickness, and only 3% of patients undergoing laparotomy have full-thickness colonic tears.<sup>7</sup>

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In patients with clinically suspected colorectal perforations, the radiological diagnosis of pneumoperitoneum can be made using chest or abdominal radiographs or both.<sup>8</sup> Further imaging is often not required if the clinical picture clarifies the likely cause and if further imaging would delay surgical management. Computed tomography (CT) has a pivot role in planning the surgical treatment, the prognosis, and in assessing those patients who have clinical symptoms of peritonitis but no radiographic signs of perforation.<sup>9</sup>

This article illustrates the role of multidetector row CT (MDCT) in the diagnosis of colorectal perforations.

## Causes and Physiopathology of Large Bowel Perforations

Colonic perforations can be classified into perforation that occur at the site of a localized pathologic process (diverticulitis,

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carcinoma, and foreign bodies) and cecal perforations that occur secondary to distal colonic obstructions.<sup>10</sup> The obstructive process leads to severe colonic distension mostly when the ileocecal valve is competent and the colon cannot decompress. Cecum, having the largest transverse diameter, develops high intraluminal pressures and the highest wall tension that leads to diastatic perforation. Risk of cecal perforation is high when there is rapid colonic distension, when the cecum reaches 12 cm in diameter, and when the intraluminal cecal pressures are more than 20 mm Hg.<sup>11</sup> Moreover, colonic perforations could be divided into the following 2 categories: nontraumatic perforations (caused as a complication of diverticulitis, inflammatory chronic disease, neoplastic lesion, ischemia, or as a postoperative complication) and traumatic perforations. The perforation sites of the large bowel can be frequently correlated with their causes<sup>12</sup>: perforations from malignant neoplasm, diverticulitis, blunt abdominal trauma, ischemia, and spontaneous perforation tend to occur in the left colon, whereas those from inflammatory lesions and penetrating trauma are frequently observed in the right colon.<sup>13</sup>

Spontaneous perforation of the colon is defined as a sudden perforation of the normal colon in the absence of diseases such as tumors, diverticulosis, or external injury.<sup>14</sup> The cause of spontaneous colonic perforation is usually unclear. The disease has often been seen in patients with chronic constipation: in these cases, the solid feculent mass compresses the colonic wall, diminishes the blood supply, and leads to ischemia and necrosis of colonic mucosa, which forms marked feculent ulcer changes. Iatrogenic injuries usually involve the rectum and the sigmoid colon. The incidence of iatrogenic large bowel perforations ranges from 0.1%-0.9% and from 0.01%-0.04% after colonoscopy and barium enemas, respectively.<sup>15</sup> The overall risk of postcolonoscopic perforation that requires operation or that leads to mortality is very low, reported as 0.2% of diagnostic and 0.3%-0.4% of therapeutic colonoscopies. The rectosigmoid is the most common site of perforation caused by a diagnostic examination followed by the cecum. The most common site of a postpolypectomy perforation is, as expected, at the site of the excised polyp.<sup>16-18</sup> Colonic perforation during contrast study of the colon can be classified into intramural, retroperitoneal, and intraperitoneal depending on the site and depth of the colonic wall injury. The barium extravasation is often recognized during fluoroscopy, but may be overlooked with a delay in treatment.<sup>18</sup>

Colonic perforations may present without immediate perforation-associated pain and tend to have a slower clinical progression. Penetration of the serosal layer of the large intestine may lead to either a covered perforation, with phlegmon and abscess formation and localized peritonitis, or less frequently to free perforation into the retroperitoneum or the intraperitoneal cavity, depending on the involved colonic segment. The clinical and laboratory data can help in establishing the cause of the perforation<sup>10,19</sup>; the type and degree of peritoneal contamination depend on the site, size, and duration of the perforation and on the physiological state, including the time from the last meal, administration of a mechanical bowel preparation before the perforation,

coexistent diseases, and the presence or absence of an ileus or bowel obstruction with accompanying bacterial overgrowth.<sup>20</sup>

Traumatic colonic perforations are often caused by blunt trauma, occurring in 2%-15% of patients.<sup>21</sup> The main causes reported in literature are motor vehicle collisions, motorcycle injuries, assaults, pedestrian-vehicle collisions, child abuse, and bike handlebar intrusions. Incorrect placement of safety belts has been implicated as an additional risk factor. The most frequent type of injury of the colon is hemorrhagic contusion, followed by serosa tears, which occur most commonly in the transverse colon. Severe injuries occur more commonly in the sigmoid, right colon, and cecum, where frank rupture or devitalization from vascular compromise may result. Colon injury from blunt abdominal trauma shows different localizations: Bugis et al<sup>21</sup> reported primarily left-sided injuries whereas Howell et al<sup>22</sup> reported that the transverse colon was most frequently injured. Injury of the transverse colon appears to have more associated lesions than other sites of colonic injury. In the series reported by Dauterive et al<sup>23</sup> the most frequently encountered intra-abdominal injuries involved the liver (64%), spleen (52%), and small bowel mesentery (48%). Involvement of the transverse colon also increased the likelihood of pancreaticoduodenal injuries.

## Causes and Physiopathology of Rectal Perforations

Rectal perforation may result from foreign bodies inserted into the rectum: as with upper gastrointestinal foreign bodies, the types of objects introduced through the anus are unlimited. A useful classification of rectal foreign bodies has been to categorize them as voluntary vs involuntary and sexual vs nonsexual. One of the most common category of rectal foreign bodies is objects that are inserted voluntarily and for sexual stimulation.<sup>24</sup> Patients usually present to the emergency department because of anorectal, pelvic, or lower abdominal pain, often after failure of multiple attempts to remove the object.<sup>25</sup> The delay in presentation and multiple attempts at



**Figure 1** Axial view of MDCT scan. Evidence of extraluminal air (arrow) and extraluminal free fluid (arrows) in a patient with perforation from cecal ischemia.

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