

Management of Colonoscopy Perforation and Endoscopic Findings

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Abstract

Colonoscopy is the criterion requirement for recognizing, screening, and security for colorectal cancer, inflammatory bowel disease and other conditions of the huge bowel. In a across the country study, an approximated 15 million colonoscopies were performed in 2012 in the United States alone An overall of 3,371 titles were recognized through our search. 31 articles were deemed proper for inclusion. This consisted of 31 retrospective evaluations. No potential studies, randomized regulated trials or meta-analyses were identified. Colonoscopic perforation is a rare event and released management techniques are marked by their heterogeneity. Dependable conclusions are limited by the nature of the information offered-- primarily single organization, retrospective research studies. When compared to diagnostic colonoscopy and the sigmoid as the most common site of perforation, consensus conclusions include a higher rate of perforation from restorative colonoscopy. Death appears driven by pre-existing conditions. Treatment needs to be customized according to the patient's comorbidities and clinical status as well as the specific conditions during the colonoscopy that resulted in the perforation.

• Introduction

Colonoscopy is the criterion requirement for identifying, screening, and security for colorectal cancer, inflammatory bowel disease and other conditions of the big bowel. In a.

nationwide study, an approximated 15 million colonoscopies were carried out in 2012 in the United States alone ⁽¹⁾. The most severe common issue of colonoscopy is perforation. Rates.

variety from 0.016% to 0.8% for diagnostic colonoscopies and as much as 2.1% for therapeutic colonoscopies including endoscopic mucosal resection (EMR) ⁽²⁻⁴⁾.based research studies in-depth total colonoscopic perforation rates of 0.12% ⁽¹⁾ and 0.082%⁽²⁾. Patients can provide with perforation at variable times, from recognition during colonoscopy to delayed discussions greater than 24 Hour later on. Symptoms vary from focal abdominal pain to generalized peritonitis and sepsis. Alternatives for treatment are several and consist of observation, endoscopic closure, surgical repair and surgical resection. These events can be quite serious. With reported morbidity rates of up to 55% ⁽⁷⁾ and death rates that range from 0 to 25% ^(8, 9). Decision of the appropriate treatment for any provided patient is convoluted and far from standardized.

We performed a methodical review of interventions for colonoscopic perforation to much better comprehend ideal care of these patients. By comparing different treatments and evaluating outcomes, our goal was to create an easy algorithm to guide the professional in the care of this unusual however serious problem. While we acknowledge the function of endoscopic management, consisting of clipping, we focused on determining the group of patients that will benefit the most from surgical management.

• Methodology

This systematic review was performed according to the preferred reporting items for systematic review and meta-analysis protocols (PRISMA-P) guidelines⁽¹⁰⁾. An up to date, comprehensive current search of PubMed, Embase, CINAHL and Cochrane Database of Collected reviews was performed from January 1979 through October 2016. Keywords used in this systematic search are available in [Appendix 1](#). Authors separately reviewed abstracts to determine relevance to this current study. **COCHRANE** (colon OR colonic OR colonoscopic) AND (perforation) AND (surgery or surgical or management). We included all articles describing the management of colonoscopic perforation in an adult population. We excluded articles older than 10 years with an

exception for those with marked importance. Articles must have been written in the English language and include human subjects older than 18. All case reports and review articles were excluded. Full text review of all appropriate articles was performed.

• **Results and Discussion**

Study Selection and characteristics

A total of 3,371 titles were identified through our search. 31 articles were deemed appropriate for inclusion. This included 31 retrospective reviews. No prospective studies, randomized controlled trials or meta-analyses were identified. Selected studies are presented in [Tables 2 and 3](#).

Risk Factors for Perforation

Five main mechanisms have been recognized for perforation and can be divided into colonoscopy trauma versus therapeutic steps⁽¹²⁾. With poor visualization, the pointer of the colonoscopy may directly bore the bowel wall. Second, bowing of a loop of the colonoscopy can cause sufficient lateral pressure to perforate the colon wall. Third, perforation may occur at a pathologic location of the colon e.g. stricture, tumor, diverticulum. Fourth, aggressive air instillation can trigger increased colonic baropressure which ruptures the colon. Fifth and finally, perforation can accompany a restorative procedure such as snare polypectomy, direct thermal injury and EMR.

Across most of research studies, perforation took place at a higher rate in healing colonoscopies compared with diagnostic colonoscopies. However, data suggested that the size of perforations that happened during diagnostic colonoscopies was considerably larger than those that took place throughout therapeutic colonoscopies and the patients presented earlier^(9,13). There likewise is irregularity amongst therapeutic colonoscopies with EMR having the highest rate of perforation reaching up to 2.1%^(4,14). The sigmoid⁽¹⁵⁾. This is believed to be credited to its redundancy and luminal narrowing⁽¹⁵⁾ also seems a greater threat of colonoscopy-associated perforation in Inflammatory Bowel Disease (IBD) patients with active disease and on steroids⁽¹⁴⁾.

A fascinating threat element is the role of intraabdominal adhesions from previous surgery. In the report from Hansen et al, all but 2 patients (82%) that suffered perforation had undergone at least one prior abdominal or pelvic surgery⁽¹⁷⁾.

The biologic basis for this observation could be that adhesions lower the capability of the colon to move with the endoscopy and lead to tethering and tearing. Zhang et al observed that most of the perforated patients had serious comorbidities such as liver cirrhosis, long-lasting steroid hormone consumption, previous intra-abdominal surgery and inflammatory bowel disease, which only serve to worsen the results of colonic perforation⁽¹⁸⁾.

Diagnosis

Recognition of colonic perforation falls under 3 windows-- instant (at time of colonoscopy), early (<24h) and late (>24h). These differences have profound implications as to management and outcome. For patients determined immediately, there is the potential to place endoscopic clips at the time of colonoscopy. Both Medeburg et al and Kim et al utilized this strategy with great outcomes and a conversion rate to surgery of 11% in both research studies^(2,4). Yang et al promoted that if the perforation is noted at endoscopy and not able to be clipped, then the patient should proceed straight to surgical expedition⁽¹⁹⁾.

There is a constellation of symptoms that professionals have to know for patients whose perforations are not identified at the time of colonoscopy. The majority of patients with a colonic perforation will manifest symptoms. Across studies, abdominal pain was the most consistent symptom. The most regular occurring sign was tachycardia (54%), abdominal distention (59%), followed by securing and rebound inflammation, fever, hypotension and leukocytosis (20). Avgerinos et al found that only 6% of patients with recognized perforation remained

Asymptomatic⁽¹²⁾. A number of diagnostic approaches are readily available for validating the diagnosis of colonic perforation. Decubitus or upright abdominal radiographs can discover pneumoperitoneum but are insensitive to the existence of fluid⁽²¹⁾. If pneumoperitoneum is accompanied by sepsis and/or scattered peritonitis with a high suspicion of perforation, then immediate expedition is suggested. Both computed tomography (CT) and water soluble enema

have the included benefit of potentially determining the area of the perforation, which can be valuable in operative planning. CT has a number of benefits including the ability to envision perforation into the mesentery and retroperitoneal ⁽²¹⁾. A water soluble enema has the prospective drawback of increasing abdominal contamination due to the instillation of contrast under pressure. It must be kept in mind that the presence of free air, even in big amounts, does not necessitate emergency situation surgery in a patient without scattered peritonitis or abnormal vital signs. (Table 4) We advise evaluation with CT scan unless the patient has scattered peritonitis, sepsis or irregular crucial signs. In these instances, upright or decubitus abdominal radiographs need to be gotten to verify pneumoperitoneum. (Grade 2C).

For those with training in laparoscopy, a diagnostic laparoscopy is an alternative for both evaluation and treatment. The procedure is connected with low morbidity and enables conversion to a therapeutic procedure. If needed, aspects of laparoscopic assessment must include evaluation of fecal contamination and visual assessment of the colon and anus with laparoscopic mobilization. Restrictive lung disease, prior abdominal operations and cosmetic surgeon inexperience are all relative contraindications to diagnostic laparoscopy.

Though they exist on a spectrum, there is a clear distinction in between patients that present early and patients that present late with a colonic perforation. Patients that present early are usually recognized prior to discharge from the endoscopy unit. Their perforations are normally due to colonoscope pressure rather than thermal injury. Luning et al's research study in 2007 kept in mind that therapeutic treatments reveal a hold-up in discussion and diagnosis compared to diagnostic procedures ⁽²²⁾.

contamination (50% vs 17%) at the time of exploration and were more likely to undergo primary repair work or resection with anastomosis rather than an ostomy (67% vs 36%). In addition, they were Patients providing within 24 Hour were more likely to have very little peritoneal likewise most likely to have fewer medical facility complications and a much shorter healthcare facility stay^(23,24).improved outcomes likely show the benefits of early treatment of abdominal contamination.

MANAGEMENT

Endoscopic Repair

As endoscopists end up being more facile with closure of EMR defects with endoscopic clips and "over-the-scope-clips" the principle of endoscopic management of colonoscopic perforation has evolved. A full review of this treatment modality is beyond the scope of this manuscript, however a number of articles describe success with this procedure^(2, 4, 13, 15). These research studies report a high technical success rate (71-92%) with low conversion to surgery rates (11-22%). Not remarkably, a major predictor of successful colonoscopic management is smaller sized perforation size⁽²⁵⁾. Risk elements connected with the requirement for early surgical treatment within 24 Hour after colonoscopic clipping consist of big perforation, leukocytosis, fever, abdominal pain and a large amount of free air⁽¹³⁾. While studies show enhanced results with endoscopic clipping, consisting of decreased length of stay^(4, 25) and lower cost⁽¹⁵⁾, they are confounded by the reality that patients who need exploration usually have actually stopped working conservative steps and have a higher burden of comorbidities.

Observation

Observation is a proper management for patients in whom a perforation is determined but remain without diffuse peritonitis or irregular crucial indications. (Table 4) Patients with colonoscopic perforation vary from patients with traumatic or diverticular perforation as they take place in a bowel that has been cleared of fecal product. Mild abdominal pain is acceptable, however scattered peritonitis, tachycardia, hypotension, and other indications of sepsis ought to prompt instant surgical exploration. Hallmarks of observation treatment consist of nilperos, serial abdominal evaluation and broad spectrum prescription antibiotics targeting lower GI tract pathogens. Information on the ideal prescription antibiotics programs are doing not have. Only Medeberg et al explained the specific treatment of ceftriaxone and metronidazole and reported an

11% conversion rate⁽²⁶⁾. Period of hospitalization and antibiotic treatment likewise do not have evidence based assistance. With cessation of abdominal pain and anorexia, an oral diet plan can be set up. Once bowel function has actually been shown, prescription antibiotics can be transitioned to oral. Long as patients remain pain complimentary, they can be released to house on a low residue diet plan. Antibiotic period ought to parallel that for diverticulitis 7-10 days. Remarkably, there is data from Averginos et al to suggest that patients suffering perforation during healing colonoscopy were more likely to be managed conservatively⁽¹²⁾. This might be because of the smaller size of perforations sustained throughout therapeutic interventions.

Conversion to surgery is obligatory for patients with clinical degeneration. This consists of scattered peritonitis, increasing leukocytosis, and increasing tachycardia⁽²⁷⁾. With the exclusion of one removed study, conversion rates throughout the selected research studies ranged from 3-22%. No study analyzed predictors of failure of observation therapy. A research study from An et al found that length of stay and issue rates were considerably greater in the patients who required conversion compared to patients who went through instant operation⁽²⁵⁾.

Surgical Treatment

Surgical treatment is the main treatment for patients with a big perforation or diffuse peritonitis in addition to patients who stop working observational therapy⁽²⁷⁾. There are a variety of problems to think about with surgical treatment of colonoscopy perforation consisting of method, type of repair and whether to not to perform fecal diversion. In each case, it is paramount to consider the reason and pathology of the preliminary colonoscopy. The pathology of any colonoscopic biopsy or gotten rid of lesion must be reviewed if readily available. For patients with neoplasia, an oncologically sound operation needs to be performed if the patient is steady. (Table 4) For any patient with an obstructive sore, the area of obstruction must be dealt with at the time of surgery. Finally, in patients with active inflammatory bowel disease, repair is not an option and a suitable resection based upon extent of disease must be carried out. These patients are frequently on high dosage steroids and diversion should be highly considered.

The decision to perform a laparotomy versus a laparoscopic approach ultimately lies with the laparoscopic experience of the cosmetic surgeon. Numerous studies show not only the expediency of the laparoscopic approach, but likewise its broad usage^(18,28-31). In the report from Blier et al, patients who underwent open versus laparoscopic repair had equivalent operative (OR) times, shorter length of stay, fewer issues and shorter cut length⁽²⁹⁾ Coimbra et al identified higher rates of morbidity and mortality in the laparotomy group compared with the group dealt with laparoscopically, but this was clearly puzzled by the much higher rates of primary repair work in the laparoscopic group⁽³²⁾. An association between timing of diagnosis and laparoscopic repair was kept in mind by Cho et al. All patients with an early diagnosis of perforation were treated with laparoscopic simple closure. However, for the patients whose surgery was delayed more than Two Days, open laparotomy with colon resection and diversion was required due to the development of peritonitis and edema of the colon at the site of perforation⁽¹³⁾. Based upon the data, we advise the laparoscopic approach for any early diagnosed colon perforation supplied the surgeon has adequate laparoscopic skills. (Grade 2C) Laparotomy and definitive management of the perforation is constantly suitable. When the perforation is determined, the question ends up being ways to best repair work the colon. The two primary alternatives are main repair and resection. Main repair work can include oversewing the defect either open or laparoscopically. The repair work ought to be carried out in a transverse orientation to prevent stricturing. Primary repair seems more effective in patients who present early, have smaller perforation and do not have considerable fecal contamination. In those patients in whom main repair work is not proper, resection with or without an anastomosis is appropriate. This group consists of those in who the perforation happens in bowel that contains tumor, is strictured or involves a long section with significant inflammation. Lastly, the role of fecal diversion is thought about. Released stoma rates range from 32% -38%^(7, 24). Fecal diversion should strongly be considered anytime there is a question about the stability of a repair or anastomosis. Stoma development is likewise appropriate with significant peritoneal soilage, late diagnosis, significant comorbidities and hemodynamic instability. In the report from Teoh et al, the predictors of stoma formation consisted of moderate to extreme peritoneal contamination and the presence of deadly colonic neoplasms⁽⁹⁾. Stomas are likewise carried out for anastomotic leakage. Another research study from Iqbal et al cited a 2% leak rate after main anastomosis that needed stoma development⁽²⁴⁾.

Stoma reversal after repair work of colonic perforation is generally effective, with Garbay et al reporting a rate of 83%⁽³⁴⁾. Lastly, Averginos et al determined a pattern far from stomas over a Twenty Years duration⁽¹²⁾.

Rectal Perforation

Perforations in the anus are due to retroflexion. The secret is whether the perforation occurs intra or additional peritoneal. If the perforation is intraperitoneal, treatment mirrors colonic perforation, with additional factor to consider of diversion due to the unforgiving nature of a pelvic leakage. When it comes to a high rectal perforation that extends above the peritoneal reflection, mobilization of the rectum might be required and diversion is extremely advised regardless of the type of repair work. (Grade 1C) Extraperitoneal perforations permit the possibility of a transanal repair with either transanal endoscopic microsurgery (TEMS) or transanal minimally invasive surgery. (TAMIS) Kim et al reported the successful management of three patients with a rectal perforation utilizing a transanal approach⁽²⁾.

Outcomes

A variety of studies have actually examined results after management of colonic perforation. Significant morbidity can happen after colonic perforation with injury infections, intra-abdominal infections and ileus being the three most acknowledged problems^(7, 24, 25). Multivariate analysis determined blunt injuries, poor bowel preparation, corticosteroid usage, conversion from observation and being older than 67 years as danger aspects for post-operative morbidity⁽²⁴⁾. Mortality accompanied differing frequency throughout studies from 0-25% in one research study⁽⁹⁾. Multiple studies identify an ASA greater than 3 as an independent predictor of mortality. Antiplatelet representatives, and cardiovascular disease have actually also been related to increased death^(7, 9). LaTorre et al found hold-up in diagnosis as a predictor of both morbidity and mortality⁽³³⁾. Generally, the sicker the patient is at the time of the perforation, the poorer their expected result^(27, 34). This crucial info for the specialist to share with patients at the beginning of treatment.

Algorithm for management

Based upon the very best readily available data, we developed an algorithm to guide the specialist in management of colonoscopic perforation. (Figure 2) If the perforation is identified at index colonoscopy, we advise an attempt at endoscopic repair work. (Grade 1C) Otherwise, clinical criteria such as abdominal exam, hemodynamic instability and increasing leukocytosis must direct the decision to proceed with observation or surgical repair work. (Table 4) When the decision is made to proceed to exploration, a laparoscopic approach is appropriate if the patient is not harmful and the surgeon has enough experience in laparoscopy. (Grade 2C) Prior to any expedition, the factor for the colonoscopy and any pathology results must be examined to guide proper resection. The choice to fix primarily versus resect needs to be based on underlying pathology, the size of the flaw, degree of fecal contamination and overall status of the patient. (Grade 1C) Diversion should be thought about for substantial peritoneal soilage, late diagnosis, considerable comorbidities and hemodynamic instability. (Grade 2C) Avgerinos et al and Makarawo et al both proposed algorithms to manage colonoscopic perforation^(12, 35). Similarities consist of reliance upon subjective abdominal examination and important signs In addition, our algorithm consists of possible colonoscopic management. The algorithm by Averginos et al consists of a gastrograffin enema, which we do not suggest due to the prospective boost in fecal contamination and the algorithm by Makarawo et al is skewed towards a laparoscopic approach. While the Makarawo algorithm was studied prospectively, the number of patients was little (N=7) and there was no comparison with a non-algorithm management friend. Further study will consist of the use of our algorithm to enhance management of these patients.

• Conclusion

Colonoscopic perforation is an unusual occasion and released management techniques are marked by their heterogeneity. Reputable conclusions are limited by the nature of the information available-single organization, retrospective research studies. Consensus conclusions include a greater rate of perforation from restorative colonoscopy when compared to diagnostic colonoscopy and the sigmoid as the most typical website of perforation. Death appears driven by pre-existing conditions. Treatment needs to be customized according to patient's comorbidities

and clinical status as well as the particular conditions during the colonoscopy that resulted in the perforation.

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Tables

Table 1- Summary Recommendations with Grading of Evidence

Recommendation	GRADE (Description)
Evaluation with CT scan unless the patient has diffuse peritonitis, sepsis or abnormal vital signs. In these instances, upright or decubitus abdominal radiographs should be obtained to confirm pneumoperitoneum.	2C (Weak recommendation, Low- or very-low quality evidence)

For patients requiring surgery, a laparoscopic approach should be performed for any early diagnosed colon perforation provided the surgeon has adequate laparoscopic skills.	2C (Weak recommendation, Low- or very-low quality evidence)
In the case of a high rectal perforation that extends above the peritoneal reflection, mobilization of the rectum may be required and diversion is highly recommended regardless of the type of repair.	1C (Strong recommendation, Low- or very-low quality evidence)
If the perforation is identified at index colonoscopy, we recommend an attempt at endoscopic repair.	C (Strong recommendation, Low- or very-low quality evidence)
The decision to repair primarily versus resect should be based on underlying pathology, the size of the defect, degree of fecal contamination and overall status of the patient.	1C (Strong recommendation, Low- or very-low quality evidence)
Diversion should be considered for significant peritoneal soilage, late diagnosis, significant comorbidities and hemodynamic instability.	2C (Weak recommendation, Low- or very-low quality evidence)

Table 2 - Study, Study design, Demographics

Study	Year	Type of Study	Country	Number of patients	Overall Perforation Rate	Diagnostic Rate
Shin et al³⁰	2016	retrospective review	South Korea	41	28/ 48,088 (0.06%)	5/40,232 (0.01%)
Aras et al²⁸	2016	retrospective review	Turkey	16	0.10%	0.05%

An et al²⁵	2016	retrospective review	South Korea	109		
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Table 3 - Study, Outcomes

Study	Year	Observation	Abx Therapy	Colonoscopic Management	Conversion/Non op failure	Surgical management
Shin et al	2016			9 (22%)	2(5%)	23(56%)
Aras et al	2016	4(25%)	"broad spectrum"	1(6%)		12(75%)
An et al	2016	55(50%)	"broad spectrum"	31(28%)	11(10%)	54(50%)
Makarawo et al	2014	1(14%)		1(14%)		6(86%)
Shi et al	2014			1(7%)		13(93%)
Kim et al	2014	3(11%)		3(11%)		24(89%)
Tam et al	2013	4(15%)	"broad spectrum"	1(4%)		22(85%)

Table 4. Criteria for either immediate surgery or failure of observation

Criteria for Either Immediate Surgery or Failure of Observation
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<ul style="list-style-type: none">• Diffuse peritonitis on exam
<ul style="list-style-type: none">• Heart rate > 100
<ul style="list-style-type: none">• Temperature > 100.4°F or < 96.8°F
<ul style="list-style-type: none">• Respiratory rate > 20 breaths/min or PaCO₂ < 32mmHg
<ul style="list-style-type: none">• White Blood Cell Count >12,000/μL or < 4,000/μL or >10% immature [band] forms
<ul style="list-style-type: none">• Mean arterial pressure < 65 mmHg or relative hypotension
<ul style="list-style-type: none">• Altered mental status

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