

Free gas in the peritoneal cavity after colonoscopy. Indication for immediate action or incidental finding in imaging tests after uncomplicated colonoscopy? Literature review

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ABSTRACT:

Colonoscopy is a routine diagnostic and therapeutic procedure. Along with the increase in the complexity of the procedures performed, the risk of complications increases. In 2017, WSES (World Society of Emergency Surgery) published the principles of safe colonoscopy. Intestinal perforation is one of the most common complications. The risk of perforation in treatment procedures such as mucosectomy or endoscopic dissection is significantly greater than the risk of diagnostic colonoscopy. The basic rule of the procedure in case of suspected perforation is close supervision over the patient's condition and the soonest possible repair of damage. The role of the endoscopist is not only early recognition, but also early treatment of damage. Immediate endoscopic treatment of lesions is an effective, final and acceptable management strategy. In patients who have undergone imaging diagnostics for another reason, free gas in the peritoneal cavity can be recognized. It does not have to mean the need for urgent surgical intervention. Patients with asymptomatic pneumoperitoneum after colonoscopy should, however, be treated as patients with suspected perforation of the large intestine and undergo careful clinical observation in accordance with WSES recommendations. Colonoscopy is a procedure with a risk of complications, which should be reported to patients qualified for endoscopy, but appropriate management reduces the risk of morbidity and mortality associated with this procedure.

KEYWORDS:

asymptomatic pneumoperitoneum, colonoscopy, complications, dissection, mucosectomy, perforation

ABBREVIATIONS

BBPS – Boston Bowel Preparation Score

BMI – Body Mass Index

CRP – C-Reactive Protein

CT – computed tomography

DCS – damage control surgery

ESD – endoscopic submucosal dissection

FCS – Colonoscopy

OTSC – over-the-scope clip

PCT – procalcitonin

SEMS – Self-Expandable Metallic Stent

WBC – white blood cell count

WSES – World Society of Emergency Surgery

INTRODUCTION

Colonoscopy (FCS) has been a routine diagnostic procedure for colorectal diseases for many years. Technological development brings expansion of the scope of therapeutic possibilities. The complexity of procedures performed during the study increases the risk of complications, of which one of the most severe is gastrointestinal perforation. Gastrointestinal perforation is a dangerous complication, often requiring urgent surgical intervention. The basic radiological symptom is the presence of free gas in the peritoneal cavity in abdominal radiography (X-ray) and/or computed tomography (CT) of the abdominal cavity. Is the presence of free gas always an indication for urgent surgical intervention?

SAFE COLONOSCOPY. MANAGEMENT OF SUSPECTED GASTROINTESTINAL PERFORATION DURING COLONOSCOPY [1] BASED ON THE RECOMMENDATIONS OF THE WORLD SOCIETY OF EMERGENCY SURGERY (WSES, 2017)

The incidence of colonic perforation in good laboratories should not exceed 0.1% of tests performed. An increased risk of perforation is usually associated with tests performed during endoscopy. In the case of polypectomy or mucosectomy, the incidence of perforation should not exceed 1%, and in the case of SEMS (Self-Expandable Metallic Stent) – 7%.

In that regard, it should be noted that although the framework of this study focuses on intestinal perforation, colonoscopy is at risk of equally severe, though rare complications, such as bleeding. The literature contains a description of spleen injuries in the form of hematoma or rupture [2, 3]. This complication requires an almost immediate surgical response and can often be associated with iatrogenic (targeted drug therapy) coagulation disorders or such related to co-morbidities. Pneumothorax during colonoscopy may also have a turbulent course. Patients at risk of chronic obstructive pulmonary disease are particularly at risk [4, 5]. It is also worth mentioning that peritoneal adhesions may lead to perforation in the mechanism of disruption of distant sections of the gastrointestinal tract, not included in the scope of investigation, such as the small intestine [6]. There are also interesting reports on appendicitis occurring in connection with performed fibro-colonoscopy [7]. They are more prone to perforation and are most likely related to pressure trauma and

occlusion of the appendix lumen through stool masses injected during colonoscopy.

The main factors of increased risk of perforation during colonoscopy are assumed to be an age over 65, female gender, low BMI (Body Mass Index), hypoalbuminemia, the occurrence of accompanying diseases with particular emphasis on Crohn's disease and diverticulosis, admission to the intensive care unit, limited experience of the health professional, testing in small centers, a history of past surgeries, symptoms of intestinal obstruction and therapy with Bevacizumab (Avastin). Patients treated with this medicine are at increased risk of spontaneous perforations and intestinal fistulas [8]. Healing of colorectal resections in individuals undergoing this therapy is also impaired [9].

The last point when it comes to groups at risk of perforation seems to be a matter for serious debate. We are referring to anesthesia of the patient for the purpose of examination. The impression very widely prevails that failure to use analgesedation reduces the risk of perforation through active collaboration on the part of the patient. Although this explanation appears logical, in large group studies no significant differences were found in the incidence of perforation in anesthetized or non-anesthetized individuals [10, 11]. Attention is also drawn to the increased tension of the abdominal wall during abdominal pain, which not only does not facilitate examination, but in itself can contribute to increasing the risk of perforation [12].

In case of physicians learning to perform colonoscopy, they should perform the examination with the assistance of an experienced endoscopist, and any challenges in the passage of the sigmoid colon, especially in women, the elderly, or in patients with diverticulum, should urge the teacher to take over the examination or to discontinue it. The endoscope should be inserted in a gentle fashion and the formation of bowel-loops should be avoided. In the event of pain, maneuvers appropriate to the clinical situation should be used (e.g. compression as a factor counteracting loss of apparatus), and upon further difficulties, the examination should be interrupted. Air used for insufflation should be administered cautiously to avoid pressure trauma, especially when there is a suspicion of the possibility of intestinal obstruction. According to the recommendations, the use of carbon dioxide for insufflation reduces intestinal tension, discomfort during the examination and the risk of perforation.

Further recommendations involve surgical endoscopy. In the case of polypectomy of en-bloc resection of flat lesions, the size of tissues covered by the loop should not exceed 2 cm, especially when the lesion is proximal to the splenic flexure of the colon. Lifting the lesion by submucosal injection with physiological saline (or saline with dye) reduces the risk of thermal damage (electrocoagulation) of the muscularis propria. The use of electrocoagulation in mixed mode reduces the depth of tissue damage, and for small polyps (less than 5 mm) it is recommended to use a cool-loop. The use of endoscopic submucosal dissection (ESD) should be reduced to well-selected (tested) cases and performed by operators trained in this technique. The risk of perforation during surgery is higher and estimated at about 3% in intraoperative assessment and about 4% of delayed perforations [13]. Nevertheless, it is also important to mention that such good results are achieved only by Japanese centers.

Patients with cancer should be advised against stenting of stenoses when taking bevacizumab. In patients with Crohn's disease in

the active phase or suspected fistula after stenting, the extension of long stenoses is not recommended. In any case of high-risk endoscopic procedures, access to multidisciplinary therapeutic teams improves treatment outcomes.

If perforation during colonoscopy is suspected, it is important to accurately describe the situation in the patient's medical records. Such a description should include: elaboration on the indication for surgery (diagnostic vs. surgical colonoscopy), found pathologies (stenoses, polyps, tumors), drugs administered during examination, with particular emphasis on the type and time of anesthesia, description of the general condition of the patient and concomitant diseases, type of gas used for insufflation, quality of preparation for the test (assessed according to the BBPS, Boston Bowel Preparation Score), time of onset of symptoms or suspected perforation, the most probable cause (mechanical, thermal trauma), finally whether there was an intention, undertaken attempt or performance of endoscopic repair and how it was done. Also, it should be described whether there are symptoms of increased intra-abdominal pressure or peritonitis observed after the procedure.

Clinical diagnosis of perforation during colonoscopy seems to be simple. In the case of extensive perforations, symptoms of peritonitis occur suddenly and are very severe, with significant bloating of the abdomen with gas. The endoscopic image does not raise any concern when the endoscopist observes an intraperitoneal positioning of the tip of the camera on the screen. The location of the site of perforation is not always so evident. Frequently, perforation occurs as a result of tension on intraperitoneal adhesions, or on a looped apparatus, as a result of pressure trauma during intestinal insufflation, during passage through a pathological change (tumor, diverticula) or as a result of applying an electrocoagulation current during therapeutic procedures (polypectomy, mucosectomy, submucosal dissection). In the latter case, symptoms of perforation may occur immediately or be delayed. Statistically, about ⅓ of perforations are diagnosed during endoscopy.

The most common site of perforation is the sigmoid colon (53–65%) – the most mobile part of the large intestine, where endoscopic loops are formed during endoscopic examination, followed by the thin-walled cecum (14–24%), hepatic flexure (9–17%) and splenic flexure (5–8%) fixated with ligament. The rectum is the rarest place of perforation (about 1%). It should however be noted that the risk of rectal damage increases with the retroflexion maneuver [14]. In so far as possible, this technique should be performed extremely cautiously with great sensitivity and rather by experienced endoscopists. Improper and forceful conduct may lead to tearing of the rectum and constitutes another mechanism for the formation of perforation.

Until now, the dominant view was that in the case of perforation of the intestine during colonoscopy, quick surgical repair of the damage is indicated as the most effective and safest method of treatment, but is it the only one [15]?

The literature devotes more and more space to minimally invasive methods, also in the context of treatment of complications. The possibility of laparoscopic treatment is an obvious consequence of the development of video surgery. However, the surgeon belongs where endoscopy fails, by nature, with its complication. The endoscopist (even if he is not a surgeon) is no longer a helpless

person and quick removal of the endoscope after diagnosing a perforation is not an adequate solution to the problem, also in legal aspects.

The methods of endoscopic management include [16]:

1. Metal clips inserted via endoscope. They bring the mucosa and submucosa closer. Originally used as hemostatic;
2. Nitinol clips inserted on the endoscope (over-the-scope clip, OTSC) bring closer the tissue of the entire thickness of the intestinal wall. They are recommended for more extensive perforations, up to 3 cm in length [17]. However, a case has been described of clipping the neighboring small bowel loop as a complication of this procedure;
3. Gastric banding perforation. Technically analogous procedure to banding esophageal varices. Due to the small size, it is recommended for small perforations, whose edges can be sucked into the cap placed on the endoscope;
4. A technique that combines the use of end loop ligatures and hemostatic clips. It requires the use of a colonoscope with two working channels. Through one we introduce end loops, which are fixed to the intestinal wall around the perforation with classic hemostatic clips and removed by attaching subsequent sealing clips. Recommended for perforation of 2–3 cm in diameter [18];
5. Self-expandable metallic stent (SEMS) – there are few reports on the use of this type of solution in the lower digestive tract. Coat stents are used for the purpose of managing perforation. However, the problem lies in their great tendency to migrate, especially in cases of perforation without intestinal stenosis;
6. Techniques using polyglycolic acid sheets and fibrin glue – described as effective in the treatment of ESD perforation [19].

Endoscopic treatment can be supplemented with percutaneous drainage of the peritoneal cavity [20, 21]. Drainage will relieve the gaseous content from the peritoneum and, if well placed, should discolor fluid reservoirs around the perforation site.

Management of mucosal damage after extensive resections, even in the absence of overt perforation, may also have preventive effects. It was observed that it reduces the risk of its occurrence especially in the case of flat large polypectomies of changes located in the right colon [22].

What is the currently adopted algorithm in the case of suspected gastrointestinal perforation after colonoscopy?

First of all – clinical observation. All patients who present abdominal pain or tenderness, abdominal distension, fever or rectal bleeding should be monitored for gastrointestinal perforation through laboratory tests, including white blood cell count (WBC), CRP (C-Reactive Protein) or procalcitonin (PCT) and imaging tests. Because we are looking for free gas, not only intraperitoneally, but also parenterally, computed tomography (CT) seems to be a more sensitive examination than a classic abdominal radiography (X-ray). In the presence of localized peritoneal symptoms, CT of the abdominal cavity and small pelvis with contrast is recommended to assess the possibility of conservative treatment of perforation.

Conservative treatment is advised for hemodynamically stable patients, without signs of sepsis and the presence of free fluid in imaging tests. Endoscopic therapy can be considered for small lesions. The decision to pursue it depends on the cause of the perforation and the endoscopist's experience. This treatment should preferably be carried out during the same procedure or within the first 4 hours of colonoscopy, especially in the case of perforation not exceeding 2–3 cm in length. If the patient develops symptoms of peritonitis, with a suspicion of a large perforation and deterioration of the general condition of the patient, as well as in the light of ineffectiveness of conservative treatment, when a lesion requiring surgical treatment was previously diagnosed in the intestine (e.g. tumor), and in poor preparation for examination, when there is a high risk of peritoneal contamination, urgent surgical treatment should be considered.

After the implementation of conservative treatment in a patient with suspected intestinal perforation after colonoscopy, supervision should be conducted by a multidisciplinary team involving surgeons. There are no recommendations as to the length of patient supervision. Decisions regarding termination of surveillance depend mainly on the general condition of the patient. This supervision should be carried out through clinical, laboratory (WBC, PCT, CRP) and imaging (CT) tests. Such patients should undergo antibiotic therapy covering the spectrum of Gram-negative and anaerobic bacteria, even if there are no signs of peritonitis. After endoscopic closure of the perforation, the course of antibiotic therapy should last 3–5 days. In the absence of symptoms of peritonitis or signs of a generalized inflammatory reaction, it may be interrupted. CT scan is recommended for early detection of abscess or peritonitis. In patients undergoing surgical treatment with proper control of the source of infection, cessation of antibiotic therapy should occur after symptoms have subsided.

A liquid diet can be introduced to the patient after 1–2 days of conservative therapy or following endoscopic treatment of perforation when the patient's general condition does not raise concern.

In patients undergoing surgical treatment, it is recommended to implement antithrombotic prophylaxis adequate to concomitant diseases.

“Scout” laparoscopy is recognized as the preferred method for dealing with patients affected by iatrogenic bowel injury after colonoscopy. The decision to pursue it should be based on the surgeon's experience and the availability of equipment. In any situation, when the operator's qualifications do not allow for proper visualization and management of the change or when the patient's condition is extremely severe (shock), conversion to open method should be considered.

The choice of a surgical method of managing the lesion should always be preceded by a thorough assessment of the peritoneal organs, with particular emphasis on previously diagnosed colon pathologies. Primary management of perforation (suture) should be considered when the colon tissues are normal and well supplied in the judgment of the surgeon. The suture should not cause increased tissue tension. Excision (refreshing) of the edges of perforation can be considered if it will not cause narrowing of the intestinal lumen. Colorectal resection should be considered when the perforation is too extensive for local management, the edges of the perforation

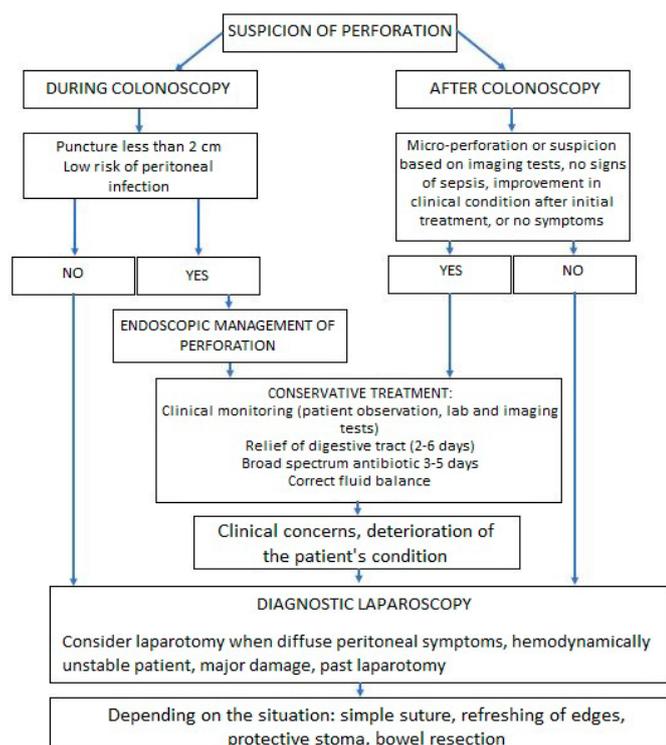


Fig. 1. Algorithm of conduct in the case of suspected intestinal perforation after colonoscopy (based on WSES guidelines).

have the characteristics of devitalized tissue, or when damage is observed within the adjacent mesentery. However, it is necessary to specify that in the case of surgical treatment of hemodynamically stable patients, techniques restoring gastrointestinal continuity are preferred, rather than Hartman procedure [23]. Attention is drawn to the possibility of using a primary protective ileostomy as protection (decompression) of the anastomosis.

Drainage of the peritoneal cavity is recommended when surgical management occurs later than 24 hours after intestinal damage, with poor bowel preparation for colonoscopy and with extensive peritoneal contamination - drainage of the peritoneal cavity. In other cases, WSES does not recommend routine peritoneal drainage.

In the group of high-risk patients, a strategy similar to trauma surgery is recommended – damage control surgery (DCS). High risk factors include an age over 67, diagnosis of perforation delayed over 24 hours, hemodynamic instability (necessity to use pressor amines before surgery), perforation caused by excessive insufflation during the diagnostic procedure, chronic glucocorticoid therapy, peritonitis with symptoms of organ failure, ASA III or IV in preoperative assessment. Less extensive procedures with proximal formation of a protective stoma supplemented with effective drainage of the peritoneal cavity are acceptable and used in clinical practice to stabilize the patient's condition with an alternative treatment for gastrointestinal perforation during colonoscopy. Intraoperative assessment by a qualified surgeon taking into account the patient's condition, underlying colon pathology and local condition of the intestine is key for making the right decision about the type of surgical treatment.

Following treatment of gastrointestinal perforation during colonoscopy, a follow-up examination can be performed after 3

to 6 months. This applies to both diagnostic colonoscopies when the test was initially not performed in its entirety or if preparation of the intestine at the time of the first test was insufficient. During this time, post-polypectomy check-ups can be conducted for radicality of resection (endoscopic surveillance) as required by applicable guidelines. In the event of massive bleeding into the lumen of the lower gastrointestinal tract or in other cases where vital colonoscopy is necessary, it should be made sure that the perforation is healed (e.g. by imaging tests) and that it is not the cause of bleeding.

The discussed algorithm of conduct in the form of a diagram is presented in Fig. 1. (based on WSES guidelines).

“X-ray image suggests perforation”, the clinic does not confirm – micro-perforation or the norm after endoscopic surgery?

Turning to literature, we find case reports of patients in whom free gas in the peritoneal cavity occurs after uncomplicated colonoscopy. The first reports date back to 1977 [24], where there is a case of a mild pneumoperitoneum, that does not require surgical intervention. Usually the symptoms are accompanied by low abdominal tenderness, without peritoneal symptoms with low or slightly elevated inflammation parameters. Signs of paralytic ileus are also observed. A similar case report was published by the Baylor University Medical Center team (Texas, USA). A 60-year-old patient undergoing carbon dioxide insufflation in colonoscopy described as uncomplicated was subject to CT angiography in the abdomen in the absence of signs of peritonitis (due to other indications). Free gas was diagnosed and the symptoms resolved after using liquid therapy and antibiotic therapy. The team postulates the need for further examination to assess the incidence of the abovementioned phenomenon [25]. It is worth mentioning, that CT scan is inefficient (especially without intravenous contrast) in the location of the perforation site and the described gas bubbles may be the only symptom. However, cases of patients who have undergone laparotomy in such a clinical situation due to suspected perforation are described. The team from Canciri in Turkey described the case of a patient undergoing surgery. The location of the perforation was not found [26]. The lesions diagnosed in imaging tests, which were the reasons for colonoscopy, turned out to be nodal changes with metastatic prostate cancer.

A man, 85 years old, treated at the General, Oncological and Endocrinological Surgery Clinic of the Provincial Combined Hospital in Kielce was qualified for endoscopic treatment of an extensive lesion of the descending colon. During the procedure, a change covering about a quarter of the circumference of the intestine located 35 cm from the sphincters was excised. Mucosectomy was performed, and the lesion was removed in four fragments of 1.5 cm each. During the procedure, no endoscopic features of transmural intestinal damage were found. No bleeding change requiring therapeutic intervention was observed from the excision site. After recovery from anesthesia, the patient reported abdominal pain. Symptomatic medications and empirical antibiotic therapy were included. Abdominal ultrasound revealed dilation of the urinary bladder. Urinary catheterization was performed. After the surgery, complete abdominal pain relief was observed. The abdominal radiograph showed “(...) a halo of free gas under the right dome of the diaphragm”. This gave grounds to perform a CT scan of the abdominal cavity, which described “(...) A small amount of gas in the upper peritoneum (...) a larger number of

scattered gas bubbles between the cecum and the gallbladder bed. Extended bowel loops bloated with gas...” After the treatment, the symptoms did not recur. The patient vomited as an undesirable effect of antibiotic therapy (Ciprofloxacin, Metronidazole) and after withdrawal from it, the symptoms resolved. The number of white blood cells in blood work did not exceed 11 K/uL. The patient was discharged on the 6th day after surgery in good general condition. The histologic results revealed “(...) numerous polypous fragments of the mucosa up to 1.5 cm. Most specimens with morphology of tubulovillous adenoma with low-grade dysplasia”.

What could be the mechanism of this phenomenon? The caecum and descending colon, most susceptible to insufflation, are stretched, and the intestinal wall thins; in extreme cases the continuity of the intestinal wall (barotrauma) is broken. A stretched intestine may become partially permeable to gas in the lumen under increased pressure. In the presented case, noteworthy is the presence of gas bubbles along the caecum and a small amount of it in Morison’s pouch, which is suggested by the abovementioned mechanism. Due to the nature of the examination, endoscopic imaging is extremely rare. Therefore, there are only single case reports. It is not clear whether free gas in the peritoneal cavity can occur without perforation and whether it is always a pathology.

Does it have any clinical implications? It should be noted that a small amount of free gas may occur in imaging tests performed on patients for other indications. Due to the rarity of this phenomenon

(0–3%), it is suggested to treat patients with free gas in the peritoneal cavity in imaging tests as suspected of gastrointestinal perforation [27]. The guidelines are clear – clinical manifestations demonstrated by the patient are decisive for initiating observation in relation to suspected gastrointestinal perforation after colonoscopy. Conduct in line with WSES recommendations appears to protect surgeons and their patients from the risk of unnecessary surgical intervention by establishing clear criteria for inclusion in the conservative treatment group.

CONCLUSION

Fiber colonoscopy is a common invasive procedure with a risk of complications that can even lead to a death of the patient [28]. Individuals qualified for the procedure should be informed about it in each case. Imaging tests performed immediately after colonoscopy for other reasons may suggest the presence of gastrointestinal perforation. Not every patient with a picture of free gas in the peritoneal cavity in imaging tests requires surgical intervention. Regardless of the reason for the presence of extraintestinal gas, the correct implication of these recommendations gives grounds for ensuring the safety of the patient and the attending physician. The process begins with proper training of endoscopists, relevant qualification for colonoscopy, vigilant endoscopic examination, and ends with attentive observation of the patient after examination, as well as accurate and quick diagnosis and treatment of complications (endoscopic and surgical) adequate to the clinical situation.

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